# METALS LEACHING DATA

# SANTORINI, GREECE

308 --- Q200408300007
Supplemental Material, Technical Activity
Supporting Documentation: Experimental Data
for Metals Leaching Data Santorini, Greece
(10/02/1992 through 10/13/1992)

Santorini Leaching Results

| SAMPLE NO. | | | MgCl2 exchangeable | | | | | | | | Carbonate fraction | | | | | | | | Fe-Mn oxides | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cu | Ag | Co | Pb | Zn | Sn | Fe | Mn | Cu | Ag | Co | Pb | Zn | Sn | Fe | Mn | Cu | Ag | Co | Pb | Zn | Sn | Fe | Mn |
| Profiles | | | | | | | | | | | | | | | | | | | | | | | | |
| (Hole I) | | | | | | | | | | | | | | | | | | | | | | | | |
| SAN-021 | 1.05 | 0.94 | 4.87 | 5.91 | 0.57 | | 5.50 | 5.67 | 1.49 | 1.50 | 5.30 | 4.71 | 1.36 | | 0.00 | 13.55 | 2.12 | 0.00 | 7.15 | 5.52 | 4.13 | | 62.09 | 83.32 |
| SAN-028 | 1.24 | 0.83 | 4.25 | 5.41 | 0.55 | | 1.13 | 4.25 | 2.99 | 0.70 | 4.84 | 4.75 | 1.17 | | 0.00 | 15.82 | 1.86 | 0.00 | 2.45 | 4.52 | 3.27 | | 127.45 | 34.45 |
| SAN-036 | 1.11 | 0.83 | 6.19 | 6.47 | 0.59 | | 1.52 | 3.75 | 1.83 | 0.84 | 4.79 | 3.88 | 1.76 | | 8.43 | 8.32 | 0.70 | 0.00 | 1.91 | 4.49 | 1.62 | | 121.81 | 13.43 |
| SAN-044 | 0.74 | 0.97 | 4.76 | 4.94 | 0.52 | | 3.63 | 4.53 | 1.53 | 0.82 | 5.03 | 4.69 | 1.76 | | 9.86 | 7.28 | 0.65 | 0.15 | 1.67 | 4.67 | 1.51 | | 74.87 | 10.55 |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| (Hole II) | | | | | | | | | | | | | | | | | | | | | | | | |
| SAN-022 | 0.68 | 0.47 | 4.48 | 1.06 | 0.37 | | 2.68 | 11.67 | 1.27 | 0.65 | 5.86 | 1.94 | 1.38 | | 0.00 | 18.48 | 1.43 | 0.19 | 8.91 | 0.63 | 5.92 | | 61.80 | 125.71 |
| SAN-029 | 1.02 | 0.66 | 4.19 | 2.88 | 0.27 | | 2.99 | 5.62 | 1.60 | 0.26 | 2.89 | 1.76 | 1.55 | | 0.00 | 9.84 | 1.07 | 0.13 | 1.79 | 0.41 | 2.70 | | 106.10 | 25.04 |
| SAN-037 | 0.72 | 0.18 | 3.22 | 1.98 | 0.34 | | 7.14 | 4.19 | 1.73 | 0.00 | 2.52 | 1.74 | 1.83 | | 6.34 | 5.81 | 0.65 | 0.00 | 1.17 | 0.45 | 1.28 | | 59.59 | 24.31 |
| SAN-045 | 0.66 | 0.20 | 2.58 | 0.83 | 0.05 | | 5.15 | 2.63 | 1.73 | 0.00 | 2.98 | 1.98 | 2.60 | | 15.55 | 7.68 | 0.63 | 0.02 | 1.28 | 0.40 | 2.12 | | 67.04 | 22.83 |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| (Hole III) | | | | | | | | | | | | | | | | | | | | | | | | |
| SAN-023 | 1.16 | 1.01 | 2.75 | 3.91 | 0.71 | | 0.84 | 9.64 | 1.88 | 0.85 | 3.22 | 5.05 | 0.79 | | 4.80 | 20.16 | 2.47 | 0.51 | 5.22 | 4.12 | 5.30 | | 39.06 | 117.94 |
| SAN-030 | 0.84 | 0.85 | 4.13 | 2.11 | 0.58 | | 1.96 | 2.48 | 1.87 | 0.82 | 4.04 | 6.14 | 1.28 | | 0.90 | 10.43 | 1.11 | 0.04 | 1.85 | 7.53 | 2.20 | | 101.68 | 24.50 |
| SAN-038 | 1.01 | 0.73 | 5.12 | 4.01 | 0.32 | | 1.15 | 2.34 | 1.67 | 0.54 | 3.82 | 4.15 | 1.94 | | 0.00 | 10.98 | 0.88 | 0.13 | 1.32 | 7.52 | 1.73 | | 99.14 | 16.17 |
| SAN-046 | 0.73 | 0.58 | 5.55 | 3.47 | 0.28 | | 1.13 | 3.55 | 1.50 | 0.35 | 3.27 | 3.55 | 2.15 | | 2.97 | 9.08 | 0.57 | 0.65 | 1.19 | 5.88 | 1.54 | | 105.60 | 17.74 |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| (Hole IV) | | | | | | | | | | | | | | | | | | | | | | | | |
| SAN-024 | 0.70 | 0.27 | 3.63 | 4.36 | 0.09 | | 2.95 | 20.49 | 1.76 | 0.39 | 6.55 | 2.38 | 1.07 | | 2.03 | 23.67 | 1.77 | 0.31 | 9.79 | 2.22 | 6.41 | | 46.50 | 83.42 |
| SAN-031 | 0.54 | 0.26 | 2.52 | 1.38 | 0.16 | | 0.70 | 2.88 | 2.52 | 0.21 | 6.67 | 1.86 | 0.77 | | 4.90 | 11.44 | 1.89 | 0.43 | 3.22 | 1.54 | 4.03 | | 55.38 | 36.80 |
| SAN-039 | 0.17 | 0.20 | 2.92 | 2.77 | 0.15 | | 1.78 | 1.59 | 2.14 | 0.12 | 2.46 | 2.33 | 1.66 | | 11.30 | 8.81 | 0.42 | 0.69 | 0.53 | 0.93 | 1.67 | | 98.92 | 12.83 |
| SAN-047 | 0.51 | 0.20 | 3.00 | 2.38 | 0.05 | | 2.12 | 2.96 | 1.83 | 0.24 | 0.81 | 0.92 | 1.75 | | 6.25 | 6.25 | 0.25 | 0.70 | 0.53 | 1.44 | 1.56 | | 82.03 | 6.80 |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| (Hole V) | | | | | | | | | | | | | | | | | | | | | | | | |
| SAN-025 | 1.06 | 0.66 | 6.11 | 4.74 | 0.55 | | 1.51 | 17.69 | 1.26 | 0.62 | 8.91 | 3.56 | 1.43 | | 5.11 | 19.05 | 1.52 | 0.06 | 10.13 | 2.75 | 6.69 | | 54.38 | 75.16 |
| SAN-032 | 0.92 | 0.68 | 4.75 | 3.86 | 0.43 | | 2.02 | 3.90 | 1.24 | 0.24 | 5.11 | 3.56 | 1.72 | | 7.24 | 8.68 | 0.71 | 0.00 | 0.85 | 2.70 | 1.69 | | 88.63 | 7.10 |
| SAN-040 | 0.39 | 0.57 | 4.96 | 5.06 | 0.41 | | 2.68 | 2.29 | 1.24 | 0.82 | 3.29 | 2.35 | 1.84 | | 12.45 | 5.66 | 0.59 | 0.13 | 0.55 | 2.80 | 1.22 | | 92.84 | 5.35 |
| SAN-048 | 0.79 | 1.02 | 5.31 | 3.57 | 0.43 | | 1.01 | 4.00 | 0.69 | 0.72 | 3.26 | 4.12 | 1.73 | | 23.58 | 6.70 | 0.41 | 0.02 | 0.63 | 2.36 | 1.07 | | 87.89 | 6.20 |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| (Hole VI) | | | | | | | | | | | | | | | | | | | | | | | | |
| SAN-027 | 0.79 | 0.70 | 2.91 | 3.35 | 0.32 | | 3.75 | 3.71 | 1.45 | 1.24 | 2.84 | 2.33 | 0.88 | | 2.31 | 15.13 | 3.12 | 0.36 | 6.27 | 2.46 | 5.02 | | 39.09 | 101.79 |
| SAN-033 | 0.62 | 0.50 | 3.80 | 3.57 | 0.52 | | 5.88 | 1.26 | 1.83 | 0.57 | 2.68 | 3.10 | 2.31 | | 0.18 | 10.79 | 1.39 | 0.00 | 1.08 | 2.04 | 3.04 | | 120.36 | 24.31 |
| SAN-041 | 0.44 | 0.41 | 3.25 | 3.04 | 0.39 | | 5.09 | 2.19 | 1.45 | 0.21 | 2.22 | 3.21 | 1.71 | | 0.00 | 8.54 | 0.63 | 0.00 | 0.95 | 2.65 | 1.35 | | 100.87 | 10.52 |
| SAN-049 | 0.44 | 0.20 | 2.88 | 2.88 | 0.67 | | 4.29 | 1.23 | 1.95 | 0.66 | 2.70 | 3.13 | 1.74 | | 0.53 | 8.49 | 0.58 | 0.00 | 0.95 | 1.69 | 1.46 | | 99.15 | 11.64 |

| | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (Hole VII) | | | | | | | | | | | | | | | | | | | | | | | | |
| Bedrock | | | | | | | | | | | | | | | | | | | | | | | | |
| SAN-035 | 1.51 | 1.18 | 7.54 | 7.88 | 1.22 | | 4.58 | 3.11 | 1.86 | 1.49 | 8.86 | 7.30 | 6.44 | | 39.22 | 9.87 | 0.92 | 0.36 | 3.39 | 5.97 | 5.73 | | 169.16 | 11.27 |
| SAN-043 | 1.51 | 0.91 | 8.04 | 6.71 | 1.00 | | 4.28 | 4.20 | 1.40 | 1.19 | 7.72 | 7.40 | 2.62 | | 33.32 | 6.07 | 0.57 | 0.25 | 2.72 | 7.53 | 1.95 | | 88.79 | 8.88 |
| SAN-052 | 1.35 | 0.84 | 6.76 | 4.47 | 0.82 | | 1.32 | 2.50 | 2.06 | 1.02 | 6.50 | 5.13 | 1.95 | | 21.90 | 7.29 | 1.57 | 0.04 | 2.12 | 4.05 | 1.97 | | 158.25 | 5.76 |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| Bedrock with | | | | | | | | | | | | | | | | | | | | | | | | |
| fractures | | | | | | | | | | | | | | | | | | | | | | | | |
| SAN-026 | 1.73 | 1.12 | 6.85 | 5.59 | 0.96 | | 0.34 | 1.11 | 2.04 | 1.25 | 7.52 | 7.55 | 3.55 | | 7.24 | 11.82 | 1.17 | 0.53 | 2.80 | 7.13 | 5.31 | | 127.50 | 16.36 |
| SAN-034 | 0.95 | 0.73 | 5.59 | 2.52 | 0.16 | | 1.32 | 3.61 | 2.37 | 0.60 | 8.45 | 7.53 | 1.65 | | 25.44 | 13.96 | 2.36 | 0.25 | 2.20 | 7.00 | 4.20 | | 211.89 | 17.03 |
| SAN-042 | 1.39 | 0.84 | 6.23 | 4.72 | 0.79 | | 3.51 | 4.01 | 2.47 | 1.10 | 6.41 | 5.76 | 1.91 | | 12.13 | 8.69 | 1.82 | 0.08 | 4.87 | 4.03 | 3.78 | | 179.35 | 13.00 |
| SAN-050 | 1.27 | 0.81 | 6.50 | 5.25 | 0.78 | | 2.48 | 4.63 | 2.36 | 1.17 | 4.89 | 5.23 | 1.98 | | 24.62 | 5.96 | 0.94 | 0.04 | 1.31 | 4.47 | 1.55 | | 95.53 | 6.81 |
| SAN-051 | 1.43 | 1.14 | 5.33 | 7.38 | 1.35 | | 1.74 | 4.67 | 2.66 | 1.62 | 5.20 | 6.80 | 2.12 | | 6.62 | 8.24 | 2.90 | 0.40 | 3.23 | 6.97 | 4.99 | | 106.90 | 25.15 |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| Base Chemistry | | | | | | | | | | | | | | | | | | | | | | | | |
| SAN-053 | 0.86 | 0.67 | 8.62 | 2.00 | 0.76 | | 5.17 | 5.04 | 1.13 | 0.65 | 6.26 | 1.87 | 2.64 | | 14.52 | 9.42 | 0.84 | 0.55 | 2.49 | 2.29 | 2.69 | | 174.29 | 11.59 |
| | | | | | | | | | | | | | | | | | | | | | | | | |

| | | MgCl2 | | | | | | | CO3 | | | | | | | FeMnOx | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Depth | Cu | Ag | Co | Pb | Zn | Fe | Mn | Cu | Ag | Co | Pb | Zn | Fe | Mn | Cu | Ag | Co | Pb | Zn | Fe | Mn |
| SAN-022 | 3.00 | 0.68 | 0.47 | 4.48 | 1.06 | 0.37 | 2.68 | 11.67 | 1.27 | 0.65 | 5.86 | 1.94 | 1.38 | 0.00 | 18.48 | 1.43 | 0.19 | 8.91 | 0.63 | 5.92 | 61.80 | 125.71 |
| SAN-029 | -4.50 | 1.02 | 0.66 | 4.19 | 2.88 | 0.27 | 2.99 | 5.62 | 1.60 | 0.26 | 2.89 | 1.76 | 1.55 | 0.00 | 9.84 | 1.07 | 0.13 | 1.79 | 0.41 | 2.70 | 106.10 | 25.04 |
| SAN-037 | -9.50 | 0.72 | 0.18 | 3.22 | 1.98 | 0.34 | 7.14 | 4.19 | 1.73 | 0.00 | 2.52 | 1.74 | 1.83 | 6.34 | 5.81 | 0.65 | 0.00 | 1.17 | 0.45 | 1.28 | 59.59 | 24.31 |
| SAN-045 | -12.00 | 0.66 | 0.20 | 2.58 | 0.83 | 0.05 | 5.15 | 2.63 | 1.73 | 0.00 | 2.98 | 1.98 | 2.60 | 15.55 | 7.68 | 0.63 | 0.02 | 1.28 | 0.40 | 2.12 | 67.04 | 22.83 |
| SAN-023 | 1.00 | 1.16 | 1.01 | 2.75 | 3.91 | 0.71 | 0.84 | 9.64 | 1.88 | 0.85 | 3.22 | 5.05 | 0.79 | 4.80 | 20.16 | 2.47 | 0.51 | 5.22 | 4.12 | 5.30 | 39.06 | 117.94 |
| SAN-030 | -3.50 | 0.84 | 0.85 | 4.13 | 2.11 | 0.58 | 1.96 | 2.48 | 1.87 | 0.82 | 4.04 | 6.14 | 1.28 | 0.90 | 10.43 | 1.11 | 0.04 | 1.85 | 7.53 | 2.20 | 101.68 | 24.50 |
| SAN-038 | -8.50 | 1.01 | 0.73 | 5.12 | 4.01 | 0.32 | 1.15 | 2.34 | 1.67 | 0.54 | 3.82 | 4.15 | 1.94 | 0.00 | 10.98 | 0.88 | 0.13 | 1.32 | 7.52 | 1.73 | 99.14 | 16.17 |
| SAN-046 | -11.50 | 0.73 | 0.58 | 5.55 | 3.47 | 0.28 | 1.13 | 3.55 | 1.50 | 0.35 | 3.27 | 3.55 | 2.15 | 2.97 | 9.08 | 0.57 | 0.65 | 1.19 | 5.88 | 1.54 | 105.60 | 17.74 |
| SAN-024 | 1.75 | 0.70 | 0.27 | 3.63 | 4.36 | 0.09 | 2.95 | 20.49 | 1.76 | 0.39 | 6.55 | 2.38 | 1.07 | 2.03 | 23.67 | 1.77 | 0.31 | 9.79 | 2.22 | 6.41 | 46.50 | 83.42 |
| SAN-031 | -4.00 | 0.54 | 0.26 | 2.52 | 1.38 | 0.16 | 0.70 | 2.88 | 2.52 | 0.21 | 6.67 | 1.86 | 0.77 | 4.90 | 11.44 | 1.89 | 0.43 | 3.22 | 1.54 | 4.03 | 55.38 | 36.80 |
| SAN-039 | -9.00 | 0.17 | 0.20 | 2.92 | 2.77 | 0.15 | 1.78 | 1.59 | 2.14 | 0.12 | 2.46 | 2.33 | 1.66 | 11.30 | 8.81 | 0.42 | 0.69 | 0.53 | 0.93 | 1.67 | 98.92 | 12.83 |
| SAN-047 | -11.00 | 0.51 | 0.20 | 3.00 | 2.38 | 0.05 | 2.12 | 2.96 | 1.83 | 0.24 | 0.81 | 0.92 | 1.75 | 6.25 | 6.25 | 0.25 | 0.70 | 0.53 | 1.44 | 1.56 | 82.03 | 6.80 |
| SAN-027 | -1.50 | 0.79 | 0.70 | 2.91 | 3.35 | 0.32 | 3.75 | 3.71 | 1.45 | 1.24 | 2.84 | 2.33 | 0.88 | 2.31 | 15.13 | 3.12 | 0.36 | 6.27 | 2.46 | 5.02 | 39.09 | 101.79 |
| SAN-033 | -4.00 | 0.62 | 0.50 | 3.80 | 3.57 | 0.52 | 5.88 | 1.26 | 1.83 | 0.57 | 2.68 | 3.10 | 2.31 | 0.18 | 10.79 | 1.39 | 0.00 | 1.08 | 2.04 | 3.04 | 120.36 | 24.31 |
| SAN-041 | -7.50 | 0.44 | 0.41 | 3.25 | 3.04 | 0.39 | 5.09 | 2.19 | 1.45 | 0.21 | 2.22 | 3.21 | 1.71 | 0.00 | 8.54 | 0.63 | 0.00 | 0.95 | 2.65 | 1.35 | 100.87 | 10.52 |
| SAN-049 | -12.50 | 0.44 | 0.20 | 2.88 | 2.88 | 0.67 | 4.29 | 1.23 | 1.95 | 0.66 | 2.70 | 3.13 | 1.74 | 0.53 | 8.49 | 0.58 | 0.00 | 0.95 | 1.69 | 1.46 | 99.15 | 11.64 |
| r-squared | | 0.164 | 0.219 | 0.002 | 0.027 | 0.043 | 0.487 | 0.025 | 0.277 | 0.381 | 0.028 | 0.491 | 0.161 | 0.594 | 0.000 | **0.721** | 0.000 | **0.826** | 0.249 | **0.720** | 0.249 | **0.720** |
| average r-squared | | 0.138 | | | | | | | 0.276 | | | | | | | 0.498 | | | | | | |

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## Delta 3 Hole I

| Sample Number | Depth cm | Error cm | MgCl2 Exchangeable Cu ppm | Ag ppm | Co ppm | Pb ppm | Zn ppm | Sn ppm | Fe ppm | Mn ppm | Carbonate Fraction Cu ppm | Ag ppm | Co ppm | Pb ppm | Zn ppm | Sn ppm | Fe ppm | Mn ppm | Fe-Mn Oxide Fraction Cu ppm | Ag ppm | Co ppm | Pb ppm | Zn ppm | Sn ppm | Fe ppm | Mn ppm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SAN-021 | 2.25 | 2.25 | | | | | | | | | | | | | | | | | | | | | | | | |
| SAN-028 | -2.50 | 2.50 | | | | | | | | | | | | | | | | | | | | | | | | |
| SAN-036 | -7.50 | 2.50 | | | | | | | | | | | | | | | | | | | | | | | | |
| SAN-044 | -12.00 | 2.00 | | | | | | | | | | | | | | | | | | | | | | | | |

## Delta 3 Hole II

| Sample Number | Depth cm | Error cm | MgCl2 Exchangeable Cu ppm | Ag ppm | Co ppm | Pb ppm | Zn ppm | Sn ppm | Fe ppm | Mn ppm | Carbonate Fraction Cu ppm | Ag ppm | Co ppm | Pb ppm | Zn ppm | Sn ppm | Fe ppm | Mn ppm | Fe-Mn Oxide Fraction Cu ppm | Ag ppm | Co ppm | Pb ppm | Zn ppm | Sn ppm | Fe ppm | Mn ppm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SAN-022 | 3.00 | 3.00 | 0.68 | 0.47 | 4.48 | 1.06 | 0.37 | | 2.68 | 11.67 | 1.27 | 0.65 | 5.86 | 1.94 | 1.38 | | 0.00 | 18.48 | 1.43 | 0.19 | 8.91 | 0.63 | 5.92 | | 61.80 | 125.71 |
| SAN-029 | -4.50 | 4.50 | 1.02 | 0.66 | 4.19 | 2.88 | 0.27 | | 2.99 | 5.62 | 1.60 | 0.26 | 2.89 | 1.76 | 1.55 | | 0.00 | 9.84 | 1.07 | 0.13 | 1.79 | 0.41 | 2.70 | | 106.10 | 25.04 |
| SAN-037 | -9.50 | 0.50 | 0.72 | 0.18 | 3.22 | 1.98 | 0.34 | | 7.14 | 4.19 | 1.73 | 0.00 | 2.52 | 1.74 | 1.83 | | 6.34 | 5.81 | 0.65 | 0.00 | 1.17 | 0.45 | 1.28 | | 59.59 | 24.31 |
| SAN-045 | -12.00 | 2.00 | 0.66 | 0.20 | 2.58 | 0.83 | 0.05 | | 5.15 | 2.63 | 1.73 | 0.00 | 2.98 | 1.98 | 2.60 | | 15.55 | 7.68 | 0.63 | 0.02 | 1.28 | 0.40 | 2.12 | | 67.04 | 22.83 |

## Delta 3 Hole III

| Sample Number | Depth cm | Error cm | MgCl2 Exchangeable Cu ppm | Ag ppm | Co ppm | Pb ppm | Zn ppm | Sn ppm | Fe ppm | Mn ppm | Carbonate Fraction Cu ppm | Ag ppm | Co ppm | Pb ppm | Zn ppm | Sn ppm | Fe ppm | Mn ppm | Fe-Mn Oxide Fraction Cu ppm | Ag ppm | Co ppm | Pb ppm | Zn ppm | Sn ppm | Fe ppm | Mn ppm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SAN-023 | 1.00 | 1.00 | 1.16 | 1.01 | 2.75 | 3.91 | 0.71 | | 0.84 | 9.64 | 1.88 | 0.85 | 3.22 | 5.05 | 0.79 | | 4.80 | 20.16 | 2.47 | 0.51 | 5.22 | 4.12 | 5.30 | | 39.06 | 117.94 |
| SAN-030 | -3.50 | 3.50 | 0.84 | 0.85 | 4.13 | 2.11 | 0.58 | | 1.96 | 2.48 | 1.87 | 0.82 | 4.04 | 6.14 | 1.28 | | 0.90 | 10.43 | 1.11 | 0.04 | 1.85 | 7.53 | 2.20 | | 101.68 | 24.50 |
| SAN-038 | -8.50 | 1.50 | 1.01 | 0.73 | 5.12 | 4.01 | 0.32 | | 1.15 | 2.34 | 1.67 | 0.54 | 3.82 | 4.15 | 1.94 | | 0.00 | 10.98 | 0.88 | 0.13 | 1.32 | 7.52 | 1.73 | | 99.14 | 16.17 |
| SAN-046 | -11.50 | 1.50 | 0.73 | 0.58 | 5.55 | 3.47 | 0.28 | | 1.13 | 3.55 | 1.50 | 0.35 | 3.27 | 3.55 | 2.15 | | 2.97 | 9.08 | 0.57 | 0.65 | 1.19 | 5.88 | 1.54 | | 105.60 | 17.74 |

## Delta 3 Hole IV

| Sample Number | Depth cm | Error cm | MgCl2 Exchangeable Cu ppm | Ag ppm | Co ppm | Pb ppm | Zn ppm | Sn ppm | Fe ppm | Mn ppm | Carbonate Fraction Cu ppm | Ag ppm | Co ppm | Pb ppm | Zn ppm | Sn ppm | Fe ppm | Mn ppm | Fe-Mn Oxide Fraction Cu ppm | Ag ppm | Co ppm | Pb ppm | Zn ppm | Sn ppm | Fe ppm | Mn ppm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SAN-024 | 1.75 | 1.75 | 0.70 | 0.27 | 3.63 | 4.36 | 0.09 | | 2.95 | 20.49 | 1.76 | 0.39 | 6.55 | 2.38 | 1.07 | | 2.03 | 23.67 | 1.77 | 0.31 | 9.79 | 2.22 | 6.41 | | 46.50 | 83.42 |
| SAN-031 | -4.00 | 4.00 | 0.54 | 0.26 | 2.52 | 1.38 | 0.16 | | 0.70 | 2.88 | 2.52 | 0.21 | 6.67 | 1.86 | 0.77 | | 4.90 | 11.44 | 1.89 | 0.43 | 3.22 | 1.54 | 4.03 | | 55.38 | 36.80 |
| SAN-039 | -9.00 | 1.00 | 0.17 | 0.20 | 2.92 | 2.77 | 0.15 | | 1.78 | 1.59 | 2.14 | 0.12 | 2.46 | 2.33 | 1.66 | | 11.30 | 8.81 | 0.42 | 0.69 | 0.53 | 0.93 | 1.67 | | 98.92 | 12.83 |
| SAN-047 | -11.00 | 1.00 | 0.51 | 0.20 | 3.00 | 2.38 | 0.05 | | 2.12 | 2.96 | 1.83 | 0.24 | 0.81 | 0.92 | 1.75 | | 6.25 | 6.25 | 0.25 | 0.70 | 0.53 | 1.44 | 1.56 | | 82.03 | 6.80 |

## Delta 3 Hole V

| Sample Number | Depth cm | Error cm | MgCl2 Exchangeable Cu ppm | Ag ppm | Co ppm | Pb ppm | Zn ppm | Sn ppm | Fe ppm | Mn ppm | Carbonate Fraction Cu ppm | Ag ppm | Co ppm | Pb ppm | Zn ppm | Sn ppm | Fe ppm | Mn ppm | Fe-Mn Oxide Fraction Cu ppm | Ag ppm | Co ppm | Pb ppm | Zn ppm | Sn ppm | Fe ppm | Mn ppm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SAN-025 | 1.00 | 1.00 | | | | | | | | | | | | | | | | | | | | | | | | |
| SAN-032 | -3.50 | 3.50 | | | | | | | | | | | | | | | | | | | | | | | | |
| SAN-040 | -8.50 | 1.50 | | | | | | | | | | | | | | | | | | | | | | | | |
| SAN-048 | -12.00 | 2.00 | | | | | | | | | | | | | | | | | | | | | | | | |

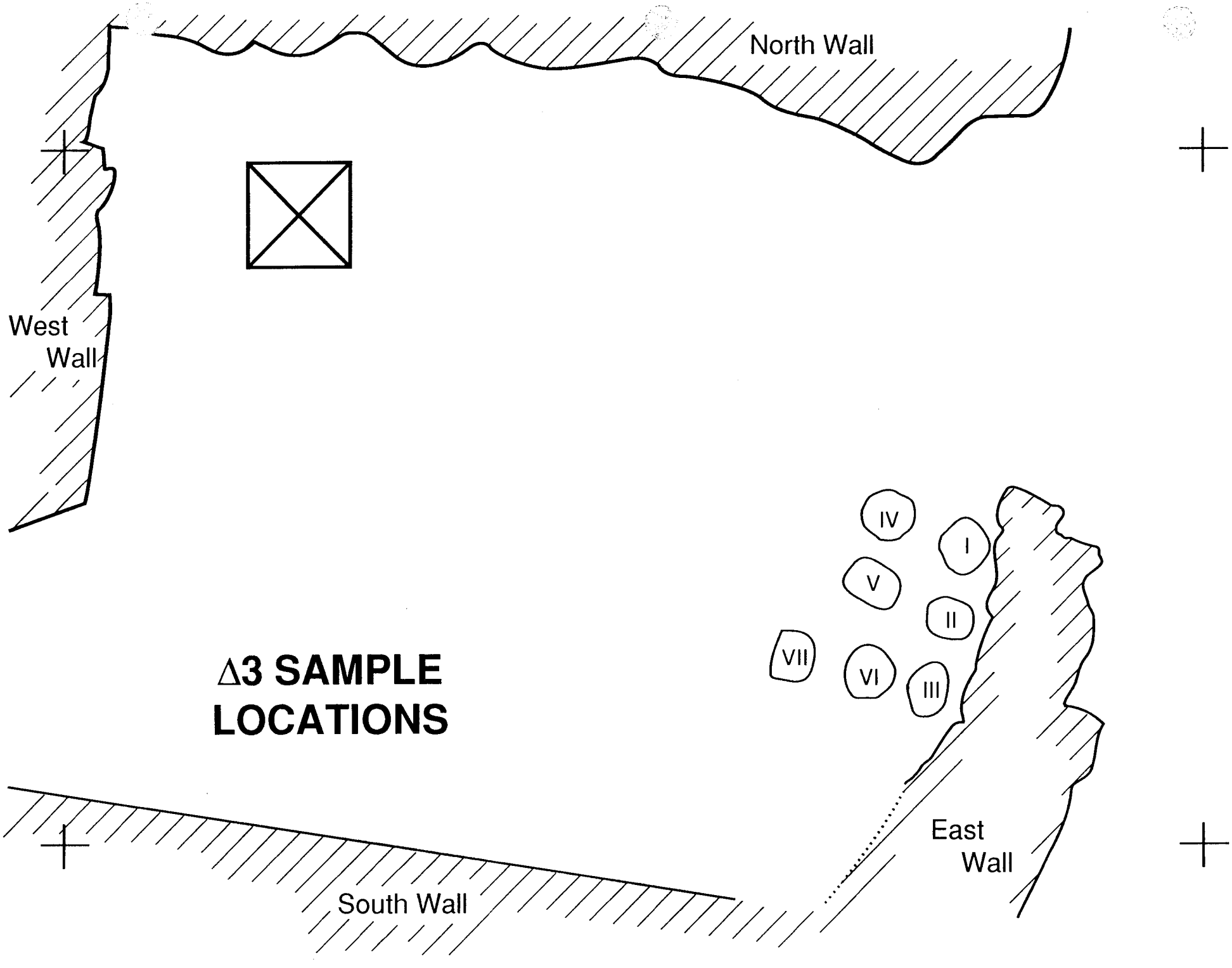
## Delta 3 Hole VI

| Sample Number | Depth cm | Error cm | MgCl2 Exchangeable Cu ppm | Ag ppm | Co ppm | Pb ppm | Zn ppm | Sn ppm | Fe ppm | Mn ppm | Carbonate Fraction Cu ppm | Ag ppm | Co ppm | Pb ppm | Zn ppm | Sn ppm | Fe ppm | Mn ppm | Fe-Mn Oxide Fraction Cu ppm | Ag ppm | Co ppm | Pb ppm | Zn ppm | Sn ppm | Fe ppm | Mn ppm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SAN-027 | -1.50 | 1.50 | 0.79 | 0.70 | 2.91 | 3.35 | 0.32 | | 3.75 | 3.71 | 1.45 | 1.24 | 2.84 | 2.33 | 0.88 | | 2.31 | 15.13 | 3.12 | 0.36 | 6.27 | 2.46 | 5.02 | | 39.09 | 101.79 |
| SAN-033 | -4.00 | 1.00 | 0.62 | 0.50 | 3.80 | 3.57 | 0.52 | | 5.88 | 1.26 | 1.83 | 0.57 | 2.68 | 3.10 | 2.31 | | 0.18 | 10.79 | 1.39 | 0.00 | 1.08 | 2.04 | 3.04 | | 120.36 | 24.31 |
| SAN-041 | -7.50 | 2.50 | 0.44 | 0.41 | 3.25 | 3.04 | 0.39 | | 5.09 | 2.19 | 1.45 | 0.21 | 2.22 | 3.21 | 1.71 | | 0.00 | 8.54 | 0.63 | 0.00 | 0.95 | 2.65 | 1.35 | | 100.87 | 10.52 |
| SAN-049 | -12.50 | 2.50 | 0.44 | 0.20 | 2.88 | 2.88 | 0.67 | | 4.29 | 1.23 | 1.95 | 0.66 | 2.70 | 3.13 | 1.74 | | 0.53 | 8.49 | 0.58 | 0.00 | 0.95 | 1.69 | 1.46 | | 99.15 | 11.64 |

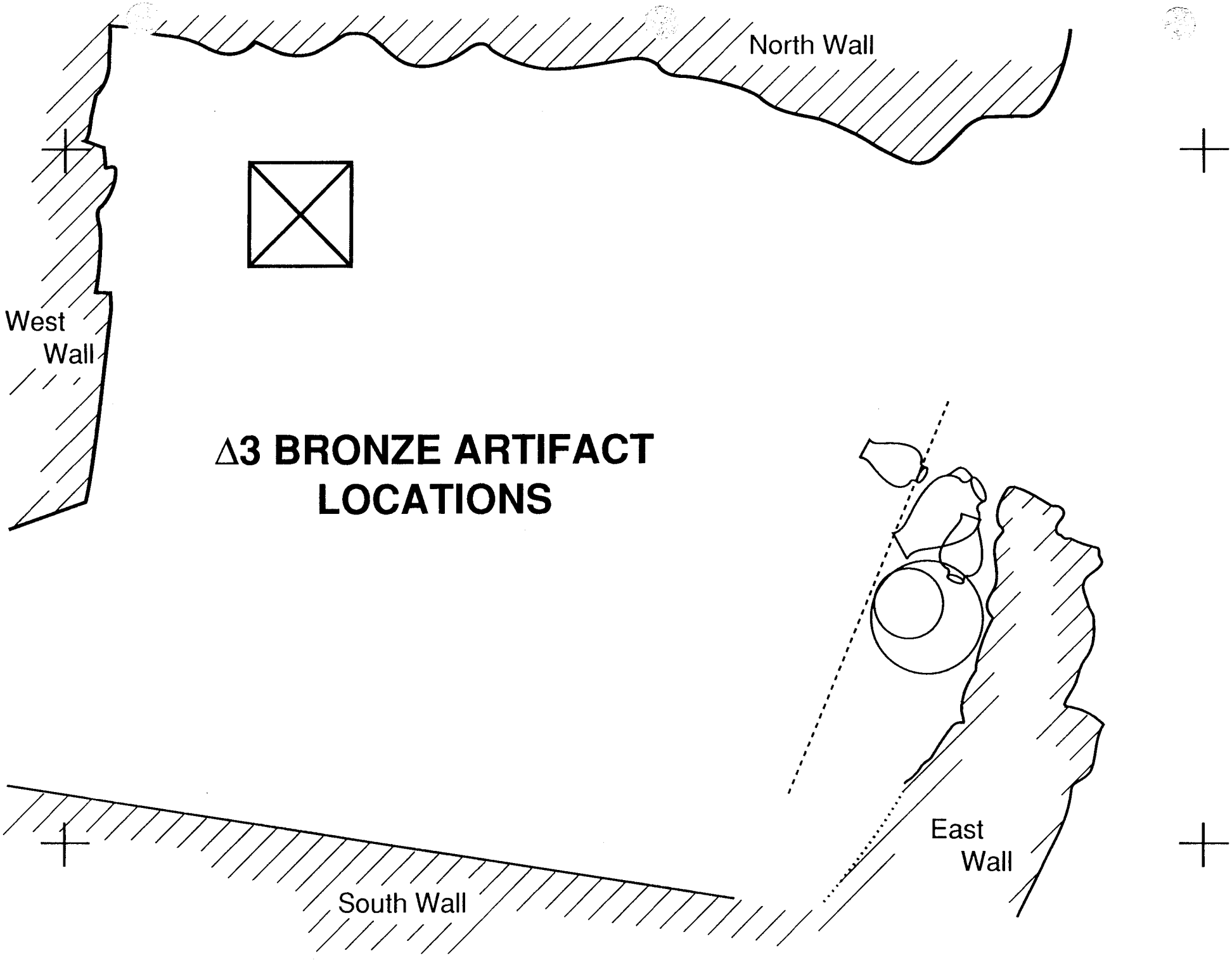
## Delta 3 Hole VII

Cape Riva w/o fracture

| Sample Number | Depth cm | Error cm | MgCl2 Exchangeable Cu ppm | Ag ppm | Co ppm | Pb ppm | Zn ppm | Sn ppm | Fe ppm | Mn ppm | Carbonate Fraction Cu ppm | Ag ppm | Co ppm | Pb ppm | Zn ppm | Sn ppm | Fe ppm | Mn ppm | Fe-Mn Oxide Fraction Cu ppm | Ag ppm | Co ppm | Pb ppm | Zn ppm | Sn ppm | Fe ppm | Mn ppm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SAN-035 | -4.00 | 4.00 | | | | | | | | | | | | | | | | | | | | | | | | |
| SAN-043 | -9.50 | 1.50 | | | | | | | | | | | | | | | | | | | | | | | | |
| SAN-052 | -13.50 | 2.50 | | | | | | | | | | | | | | | | | | | | | | | | |
| White coating in fracture SAN-034 | | | 0.95 | 0.73 | 5.59 | 2.52 | 0.16 | | 1.32 | 3.61 | 2.37 | 0.6 | 8.45 | 7.53 | 1.65 | | 25.44 | 13.96 | 2.36 | 0.25 | 2.2 | 7 | 4.2 | | 211.89 | 17.03 |
| Base Chemistry SAN-053 | | | 0.86 | 0.67 | 8.62 | 2 | 0.76 | | 5.17 | 5.04 | 1.13 | 0.65 | 6.26 | 1.87 | 2.64 | | 14.52 | 9.42 | 0.84 | 0.55 | 2.49 | 2.29 | 2.69 | | 174.29 | 11.59 |




**Δ3 SAMPLE LOCATIONS**


North Wall
West Wall
Δ3 BRONZE ARTIFACT LOCATIONS
East Wall
South Wall

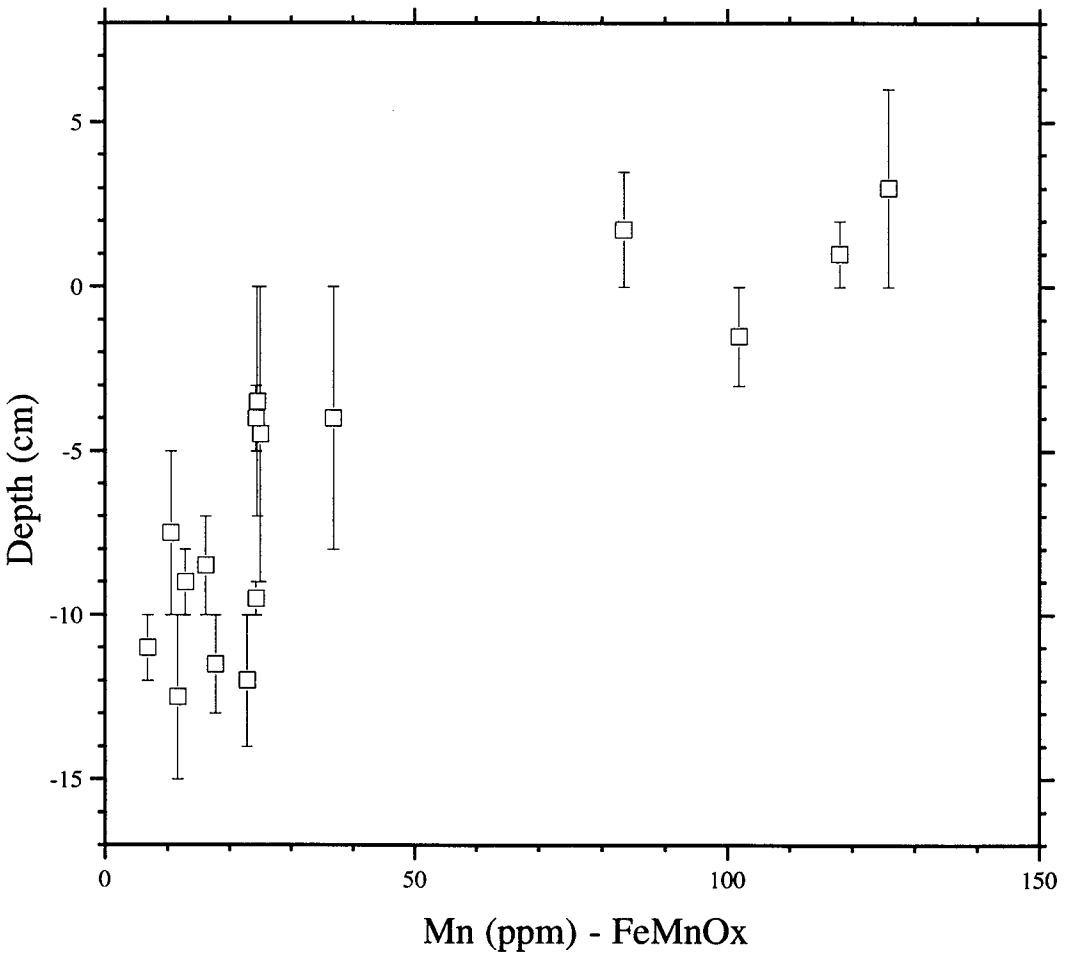
## Delta 3 vertical profile samples

| | Hole I | | Hole II | | Hole III | | Hole IV | | Hole V | | Hole VI | | Hole VII | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | Cape Riva w/o fracture | | Cape Riva w/ fracture | |
| | Interval length cm | Sample Number | Interval length cm | Sample Number | Interval length cm | Sample Number | Interval length cm | Sample Number | Interval length cm | Sample Number | Interval length cm | Sample Number | Interval length cm | Sample Number | Interval length cm | Sample Number |
| Packed Earth | 4.5 | SAN-021 | 6.0 | SAN-022 | 2.0 | SAN-023 | 3.5 | SAN-024 | 2.0 | SAN-025 | no packed earth here | | no packed earth here | | no packed earth here | |
| Cape Riva | 5.0 | SAN-028 | 9.0 | SAN-029 | 7.0 | SAN-030 | 8.0 | SAN-031 | 7.0 | SAN-032 | 3.0 | SAN-027 | | | 4.0 | SAN-026 |
| Cape Riva | 5.0 | SAN-036 | 1.0 | SAN-037 | 3.0 | SAN-038 | 2.0 | SAN-039 | 3.0 | SAN-040 | 2.0 | SAN-033 | 8.0 | SAN-035 | 8.0 | SAN-034 |
| Cape Riva | 4.0 | SAN-044 | 4.0 | SAN-045 | 3.0 | SAN-046 | 2.0 | SAN-047 | 4.0 | SAN-048 | 5.0 | SAN-041 | 3.0 | SAN-043 | 3.0 | SAN-042 |
| | | | | | | | | | | | 5.0 | SAN-049 | 5.0 | SAN-052 | ? | SAN-050 |
| | | | | | | | | | | | | | | | ? | SAN-051 |

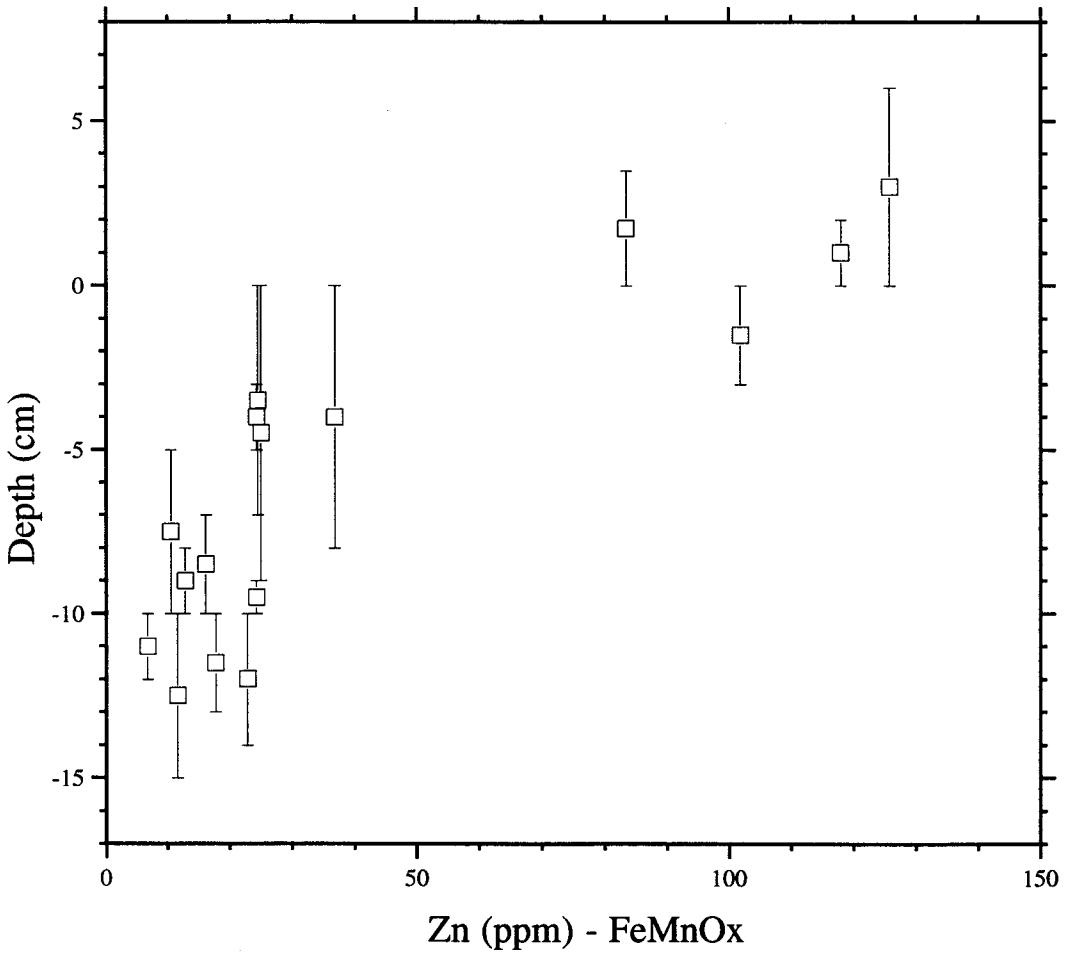
Take the top of the Cape Riva as a reference level because the thickness and existence of the Packed Earth is indeterminate across the sample area.
Depths are calculated from the top of the Cape Riva, so Packed Earth intervals will be positive numbers.
"Depth" means the vertical distance from the top of the Cape Riva to the center of the sample.
"Error" means the length range of the sample up and down from the center, calculated for plotting purposes.

| | Hole I | | | Hole II | | | Hole III | | | Hole IV | | | Hole V | | | Hole VI | | | Hole VII | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | | | | Cape Riva w/o fracture | | Cape Riva w/ fracture |
| | Depth cm | Error cm | Sample Number | Depth cm | Error cm | Sample Number | Depth cm | Error cm | Sample Number | Depth cm | Error cm | Sample Number | Depth cm | Error cm | Sample Number | Depth cm | Error cm | Sample Number | Depth cm | Error cm | Sample Number | | Sample Number |
| Packed Earth | 2.25 | 2.25 | SAN-021 | 3.00 | 3.00 | SAN-022 | 1.00 | 1.00 | SAN-023 | 1.75 | 1.75 | SAN-024 | 1.00 | 1.00 | SAN-025 | no packed earth here | | | no packed earth here | | | no packed earth here | |
| Cape Riva | -2.50 | 2.50 | SAN-028 | -4.50 | 4.50 | SAN-029 | -3.50 | 3.50 | SAN-030 | -4.00 | 4.00 | SAN-031 | -3.50 | 3.50 | SAN-032 | -1.50 | 1.50 | SAN-027 | | | | | SAN-026 |
| Cape Riva | -7.50 | 2.50 | SAN-036 | -9.50 | 0.50 | SAN-037 | -8.50 | 1.50 | SAN-038 | -9.00 | 1.00 | SAN-039 | -8.50 | 1.50 | SAN-040 | -4.00 | 1.00 | SAN-033 | -4.00 | 4.00 | SAN-035 | | SAN-034 |
| Cape Riva | -12.00 | 2.00 | SAN-044 | -12.00 | 2.00 | SAN-045 | -11.50 | 1.50 | SAN-046 | -11.00 | 1.00 | SAN-047 | -12.00 | 2.00 | SAN-048 | -7.50 | 2.50 | SAN-041 | -9.50 | 1.50 | SAN-043 | | SAN-042 |
| | | | | | | | | | | | | | | | | -12.50 | 2.50 | SAN-049 | -13.50 | 2.50 | SAN-052 | | SAN-050 |
| Total Depth | -14.0 | | | -14.0 | | | -13.0 | | | -12.0 | | | -14.0 | | | | | | | | | | SAN-051 |
| (below Cape Riva top) | | | | | | | | | | | | | | | | -15.00 | | | -16.00 | | | | |

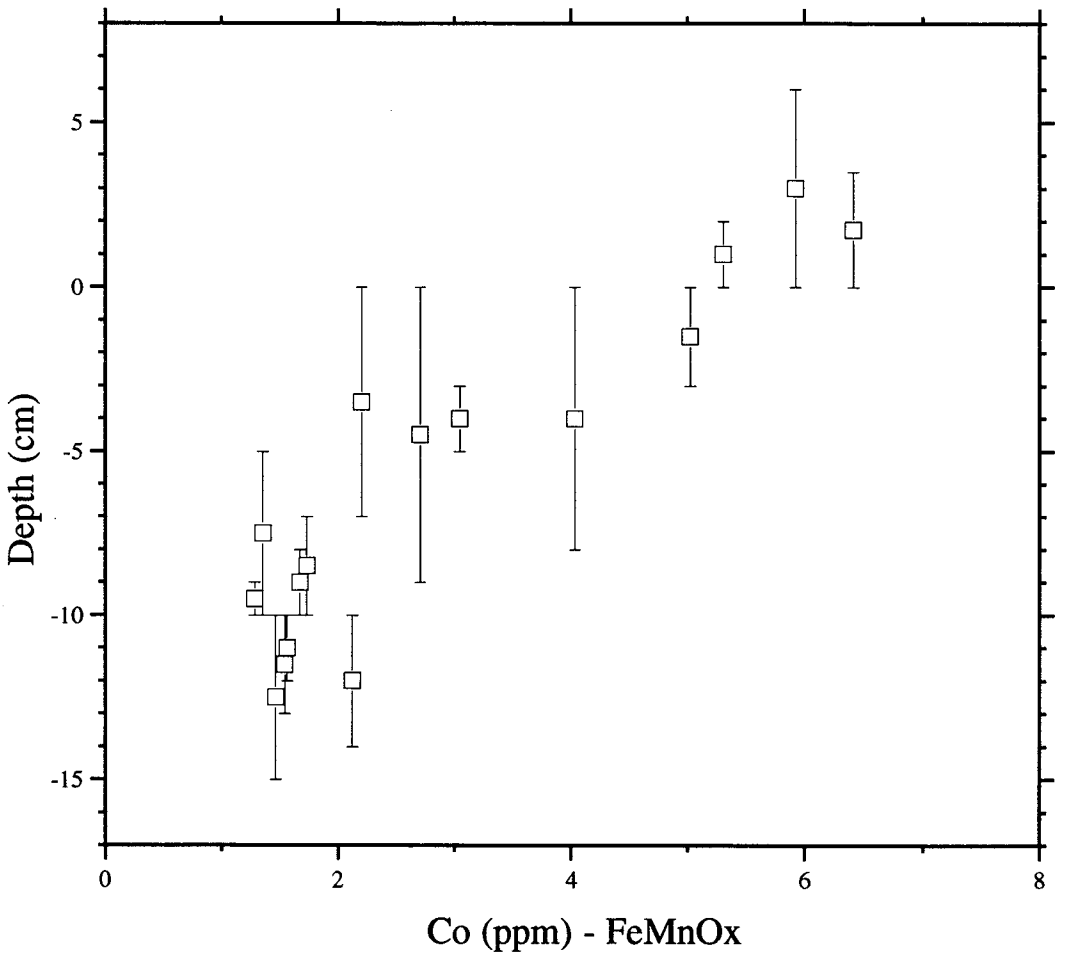
Delta 3 Profiles Corr. Data



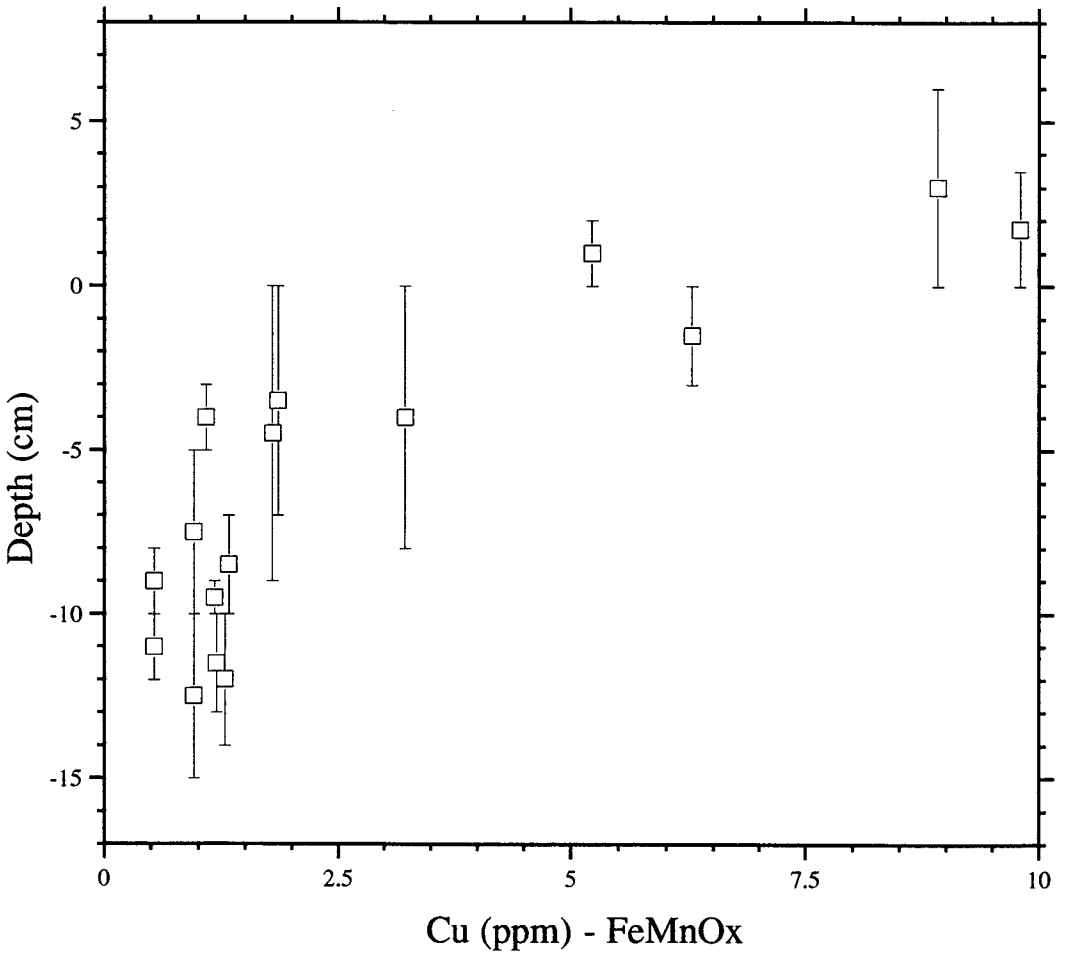
Delta 3 Profiles Corr. Data



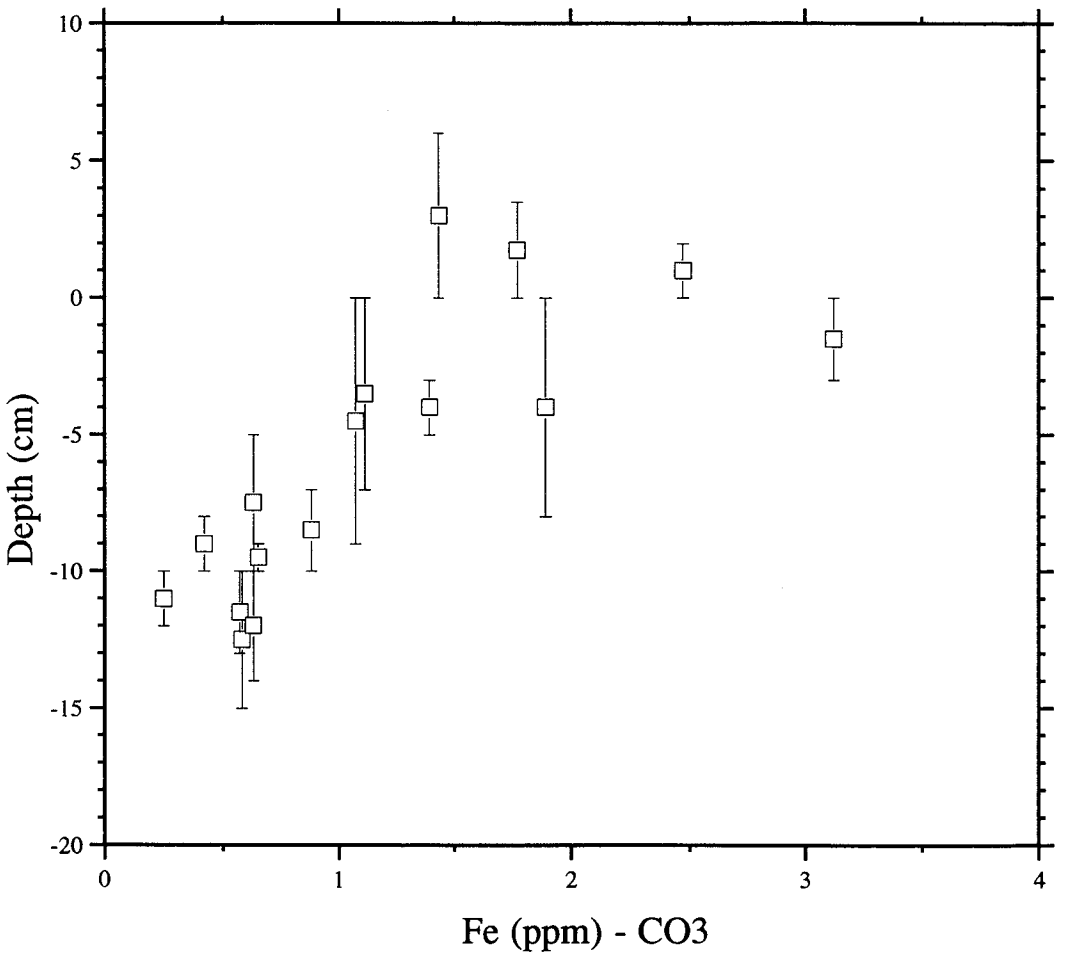
Delta 3 Profiles Corr. Data



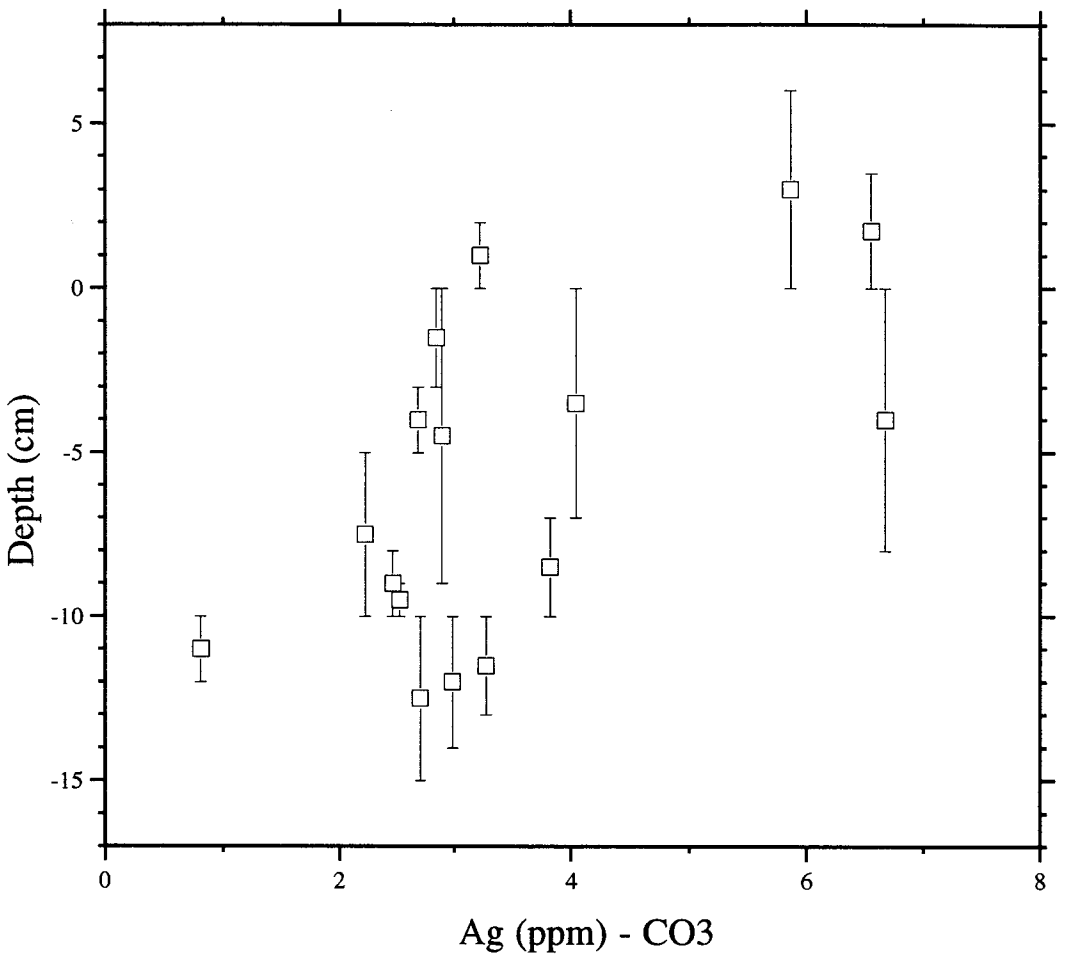
Delta 3 Profiles Corr. Data



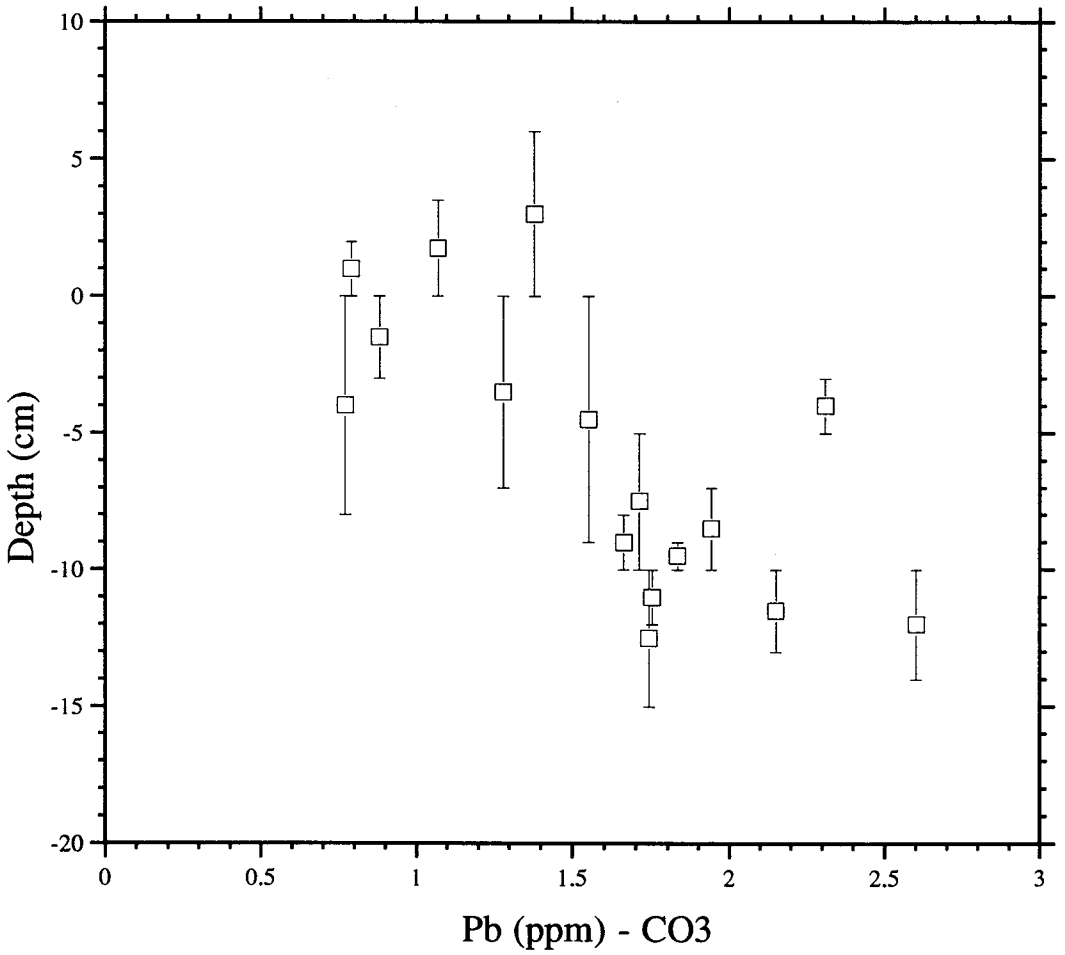
Delta 3 Profiles Corr. Data



Delta 3 Profiles Corr. Data



Delta 3 Profiles Corr. Data



R MgCl2
B
G

MgCl2 reds

| | | San-023 | SAN-030 | SAN-034 | SAN-038 | SAN-046 | SAN-053 |
|---|---|---|---|---|---|---|---|
| A | Cu | 004,005,005,004,004 | 003,004,004,003,003 | 003,002,003,003,003 | 003,002,003,002,003 | 003,003,003,002,002 | 002,003,003,002,002 |
| | Ag | ~~028 024~~ 004 005 004 004 004 | 006, 005, 005, 004, 004 | 003 003 004 004 004 | 004 003 004 004 004 | 004 004 004 004 004 | 003 004 004 004 003 |
| | Co | 007,007,006,006,006 | 010,009,010,009,010 | 013,013,013,012,013 | 012,012,012,012,012 | 012,013,012,012,012 | 020,020,020,019,020 |
| | Pb | 006, 005 005, 005, 005 | 003,004,003,003,004 ~~029,028,028,027,028~~ | 004, 004, 003, 004, 004 | 005, 005, 006,006,006 | 005, 006, 005, 004, 005 | 004, 003, 003, 004, 003 |
| | ZN | 010, 011, 010, 010, 009 | 007 007 007 006 007 | 003, 003, 002, 003, 002 | 004, 005, 006, 004, 005 | 003, 003, 003, 003, 003 | 010, 011, 010, 010, 010 |
| B | Cu | 050,052,050,051,050 | 050,049,049,050,050 | 052,050,051,053,051 | 053,055,054,054,054 | 054,053,054,054,053 | 057,054,055,054,056 |
| | Ag | 090, 090, 089, 089, 089 | 094, 094, 095, 095, 094 | 085 085 085 084 084 | 082, 083, 084, 083, 084 | 081, 081, 081, 082, 080 | 083 083 084 084 083 |
| | Co | 043,043,045,044,044 | 046,046,046,046,046 | 048,049,049,048,049 | 048,049, 049,048,049 | 048,049,048,048,049 | 055,055,056,056,055 |
| | Pb | 027 028 028, 027, 028 | 026, 027, 027, 026, 027 | 028, 027, 029, 029, 027 | 029, 031, 030, 030, 031 | 027, 028, 029, 028, 029 | 025, 026, 024, 024, 026 |
| | ZN | 127, 128, 128, 129, 127 | 122, 121, 122, 120, 121 | 114, 113, 113, 112, 113 | 115, 115, 114, 115, 116 | 115, 114, 116, 117, 115 | 120, 122, 121, 120, 121 |
| C | Cu | 101,102,102,103,100 | 101,100,101,099,102 | 100,099,100,099,098 | 103,101,102,101,101 | 105,104,104,106,104 | 105,106,105,106,107 |
| | Ag | 167 170 167 169 166 | 166, 168, 167, 166, 166 | 163, 167, 165, 164 165 | 162, ~~164~~ 164, 161, 164, 165 | 165, 164, 162, 164, 166 | 164 163, 164, 164 166 |
| | Co | 080,080,081,080,081 | 082,083,082,082,083 | 084,085,085,084,086 | 085,084,086,085,086 | 085,085,084,083,085 | 091,093,092,091,09 |
| | Pb | 051, 050 051 050 051 | 051, 051, 051, 049, 052 | 052, 051, 051, 053, 051 | 052, 053, 052, 054, 054 | 050, 051, 052, 051, 051 | 050, 049, 050 048, 050 |
| | ZN | 242, 243, 242, 243, 240 | 227, 228, 226, 227, 227 | 225, 227, 225, 224, 225 | 228, 227, 225, 224, 228 | 223, 220, 225, 222, 222 | 230, 230, 229 234, 226 |

M

# NaOAc green

| | | SAN-023 | SAN-030 | SAN-034 | SAN-038 | SAN-046 | SAN-053 |
|---|---|---|---|---|---|---|---|
| A | Cu | 006, 007, 008, 005, 007 | 007, 007, 007, 007, 006 | 009, 008, 009, 008, 008 | 006, 006, 006, 005, 006 | 006, 006, 005, 005, 005 | 004, 005, 005, 004, 004 |
| | Ag | 003 003 003 004 003 | 003 003 003 003 003 | 002 002 002 002 002 | 002 002 002 002 002 | 002 002 002 002 002 | 002 002 003 002 002 |
| | Co | 008, 007, 008, 007, 008 | 010, 010, 010, 009, 010 | 020, 020, 020, 021, 020 | 009, 009, 009, 009, 009 | 008, 008, 008, 007, 008 | 014, 014, 015, 015, 014 |
| | Pb | 007, 008, 009, 008, 008 | 010, 011, 010, 011, 010 | 011, 012, 013, 013, 013 | 007, 006, 007, 006, 007 | 006, 006, 006, 005, 005 | 003, 003, 002, 004, 002 |
| | Zn | 010, 010, 011, 011, 011 | 018, 017, 017, 018, 018 | 024, 023, 024, 024, 024 | 026, 028, 028, 026, 027 | 029 029 029 029 028 | 034, 035, 035, 034, 034 |
| B | Cu | 061, 063, 061, 060, 062 | 063, 062, 063, 062, 062 | 062, 064, 063, 065, 064 | 061, 060, 063, 062, 061 | 060, 061, 060, 061, 061 | 057, 057, 058, 058, 057 |
| | Ag | 062 062 061 063 063 | 061 060 059 061 061 | 055 055 055 056 055 | 060 061 060 059 059 | 062 063 064 063 063 | 050 051 049 050 052 |
| | Co | 046, 046, 046, 047, 046 | 048, 049, 048, 049, 048 | 058, 058, 058, 059, 057 | 046, 048, 047, 048, 047 | 047, 045, 047, 045, 046 | 052, 051, 053, 051, 053 |
| | Pb | 034, 034, 035, 033, 034 | 036, 037, 036, 035, 037 | 038, 037, 038, 038, 039 | 032, 032, 031, 032, 033 | 030, 031, 032, 030, 029 | 027, 026, 027, 026, 026 |
| | Zn | 131, 130, 132, 132, 133 | 137, 137, 136, 137, 138 | 138, 142, 137, 138, 138 | 144, 145, 148, 144, 143 | 145, 146, 146, 145, 147 | 151, 149, 149, 148, 149 |
| C ? | Cu | 117, 114, 117, 116, 117 | 120, 118, 119, 118, 118 | 119, 118, 119, 119, 121 | 115, 117, 117, 117, 116 | 117, 115, 118, 116, 115 | 114, 114, 114, 113, 113 |
| | Ag | 108 109 103 106 108 | 109 107 109 108 107 | 097 098 096 098 095 | 110, 112, 111, 110, 110 | 127 127 129 127 127 | 099 099 100 102 100 |
| | Co | 085, 083, 085, 085, 084 | 087, 086, 086, 087, 087 | 095, 097, 095, 096, 097 | 085, 084, 084, 084, 084 | 084, 084, 084, 083, 083 | 088, 089, 090, 088, 087 |
| | Pb | 060, 059, 058, 058, 059 | 063, 062, 063, 064, 064 | 064, 065, 064, 065, 063 | 057, 057, 057, 057, 057 | 055, 055, 054, 054, 055 | 050, 051, 050, 050, 050 |
| | Zn | 248, 242, 246, 244, 245 | 251, 248, 249, 247, 248 | 255, 255, 254, 254, 250 | 258, 253, 253, 255, 254 | 249, 252, 256, 251, 251 | 253, 252, 253, 252, 253 |

# ½ OH blue

| | | SAN-023 | SAN-030 | SAN-034 | SAN-038 | SAN-046 | SAN-053 |
|---|---|---|---|---|---|---|---|
| A | Cu | .010 .011 .011 .010 .011 | 005 005 005 005 005 | 011 010 010 010 011 | 005 004 003 004 004 | 003 002 002 002 003 | 004, 003, 004, 002, 003 |
| | Ag | 001 001 001 001 001 | 001, 001, 001, 001, 000 | 002 002 001 001 001 | 000, 001, 000, 000, 000 | 001 001 000 001 001 | 001 001 001 001 001 |
| | Co | 015, 015, 015, 015, 015 | 006, 005, 006, 005, 006 | 015, 014, 014, 015, 014 | 004, 004, 004, 004, 004 | 003, 004, 004, 003, 004 | 007, 007, 007, 008, 007 |
| | Pb | .008, 009, 008, 009, 008 | 014, 014, 014, 015, 015 | 013, 013, 013, 012, 014 | 014, 014, 012, 014, 013 | 011, 010, 011, 011, 010 | 005, 006, 003, 003, 005 |
| | Zn | 102, 107, 100, 097, 099 | 042, 041, 042, 042, 042 | 077, 079, 078, 080, 078 | 033, 032, 033, 033, 034 | 028, 029 029, 028, 028 | 047, 047, 048, 048, 048 |
| B | Cu | 078 077 077 080 077 | 071 070 070 070 071 | 075 076 075 075 076 | 071 072 071 070 072 | 071 072 070, 071, 071 | 070, 070, 071, 070, 071 |
| | Ag | 073 073 073 072 072 | 069, 068, 070, 070, 070 | 071, 070, 071, 070, 069 | 062, 059, 059, 060 061 | 072 071 071 071 071 | 062 061 063 060 061 |
| | Co | 062, 062, 061, 062, 062 | 053, 054, 053, 054 052 | 060, 061, 061, 062, 060 | 051, 051, 052, 051, 051 | 051, 052, 050, 051, 051 | 054, 055, 054, 053, 054 |
| | Pb | 037, 038, 037, 037, 036 | 043, 042, 042, 043, 044 | 042, 042, 041, 042, 043 | 041, 041, 044, 041, 041 | 036, 038, 035, 034, 035 | 033, 032, 032, 032, 031 |
| | Zn | 270, 269, 276, 273 270 | 196, 198, 196, 199, 196 | 229, 231, 230, 233, 234 | 189, 189, 185, 188, 188 | 183, 186, 184, 184, 186 | 206 205 203 203 205 |
| C | Cu | 126 128 125 125 127 | 137 136 137 139 138 | 144 142 144 143 144 | 139 140 139 140 139 | 139, 140, 139, 138, 139 | 137, 136, 136, 136, 135 |
| | Ag | 137, 135, 138, 137, 138 | 141, 142, 141, 143, 141 | 141, 141, 142, 141, 140 | 118, 116, 120, 120, 117 | 130, 128, 131, 130, 131 | 118 117 117 114 114 |
| | Co | 109, 107, 106, 105, 107 | 100, 102, 099, 102, 100 | 109, 109, 108, 108, 110 | 098, 099, 098, 099, 098 | 098, 099, 099, 098, 098 | 097, 102, 101, 100, 101 |
| | Pb | 069, 069, 067, 068, 069 | 072, 074, 072, 074, 073 | 072, 071, 070, 072, 072 | 070, 069, 070, 069, 069 | 065, 062, 066, 064, 062 | 060, 061, 062, 061, 062 |
| | Zn | 411, 413, 412, 421, 411 | 343, 349, 350, 342 346 | 380, 380, 377, 378, 377 | 331, 338, 340, 338, 341 | 328, 335, 336, 332, 330 | 345 343 344 346 345 |

.198

# $MgCl_2$ - D

| | | SAN-023 | SAN-030 | SAN-034 | SAN-038 | SAN-046 | SAN053 |
|---|---|---|---|---|---|---|---|
| A | Fe | 000 001 000 002 000 | 001 002 001 002 002 | 000 001 001 000 001 | 001 001 001 000 001 | 002 001 001 001 000 | 004 005 002 002 004 |
| | MN | 11 12 11 12 11 | 4 3 3 3 5 | 5 4 4 4 4 | 3 3 1 3 3 | 4 5 5 5 3 | 7 6 6 7 7 |
| B | Fe | 047 048 047 048 049 | 48 48 47 48 49 | 48 49 52 49 49 | 048 049 049 047 048 | 048 050 049 048 049 | 051 050 051 051 048 |
| | MN | 62 63 64 64 62 | 53 52 53 54 52 | 54 55 55 54 54 | 53 55 54 54 54 | 54 53 55 55 55 | 55 56 54 56 56 |
| C | Fe | 096 096 097 097 093 | 95 98 96 98 98 | 96 96 99 97 98 | 096 097 096 096 095 | 098 098 098 099 098 | 098 099 .100 097 099 |
| | MN | 111 111 111 111 110 | 103 107 104 104 104 | 103 104 103 103 102 | 102 105 102 103 102 | 106 103 104 104 102 | 106 107 106 105 105 |

Fe 1 ppm 2 ppm

MN .05 ppm 1 ppm

NaOAc green

| | | SAN-023 | SAN-030 | SAN034 | SAN038 | SAN046 | SAN-053 |
|---|---|---|---|---|---|---|---|
| A | Fe | 1 3 2 2 2 | 0 0 1 0 1 | 8 8 11 8 8 | 0 0 0 0 0 | 0 1 2 0 2 | 7 5 4 8 6 |
| | Mn | 26 25 26 25 26 | 14 13 14 13 13 | 19 17 17 17 18 | 15 13 13 12 13 | 11 13 10 10 13 | 12 13 11 11 11 |
| B | Fe | 35 35 36 34 33 | 35 36 35 36 34 | 35 36 37 34 35 | 26 29 33 30 31 | 26 27 29 26 29 | 38 37 39 40 40 |
| | Mn | 74 75 75 74 73 | 64 63 64 63 64 | 64 67 66 66 67 | 63 62 65 63 64 | 62 60 62 63 63 | 062 61 61 64 62 |
| C | Fe | 75 75 75 73 77 | 80 79 80 77 80 | 76 79 77 74 76 | 67 66 69 70 70 | 66 63 63 62 66 | 83 81 83 82 83 |
| | Mn | 123 125 124 127 122 | 114 114 113 113 116 | 118 116 117 113 118 | 110 111 111 112 109 | 112 112 110 111 112 | 112 110 110 111 112 |

$NH_2OH$ blue

| | | SAN-023 | SAN-030 | SAN-034 | SAN-038 | SAN-046 | SAN-053 |
|---|---|---|---|---|---|---|---|
| A | Fe | 10 9 8 10 8 | 25 23 25 23 23 | 47 50 50 47 46 | 24 24 21 25 21 | 22 24 24 23 27 | 39 37 38 37 36 |
| | Mn | 61 62 62 60 61 | 12 13 12 13 13 | 10 8 8 9 10 | 9 7 8 10 9 | 7 8 7 9 8 | 6 5 4 6 5 |
| B | Fe | 54 57 56 56 56 | 72 67 68 70 71 | 93 93 93 91 94 | 71 73 71 70 69 | 72 70 73 70 70 | 82 82 84 86 85 |
| | Mn | 112 114 115 114 112 | 65 63 63 63 64 | 59 60 62 62 60 | 61 62 62 61 61 | 65 63 63 64 63 | 58 57 57 58 59 |
| C | Fe | 102 103 103 101 101 | 116 116 113 118 114 | 139 139 136 136 139 | 116 115 116 115 116 | 116 116 113 114 115 | 125 126 123 124 125 |
| | Mn | 166, 162, 164, 161, 164 | 114 113 113 115 115 | 113 114 113 113 110 | 114 113 114 114 113 | 111 111 109 110 111 | 108 107 109 106 107 |

# $MgCl_2$ rec

| | | SAN-027 | SAN-033 | SAN-041 | SAN-049 |
|---|---|---|---|---|---|
| A | Cu | 3 3 3 3 3 | 2 3 1 2 2 | 1 2 3 2 1 | 2 3 1 1 1 |
| | Ag | 5 4 4 4 4 | 3 3 3 2 3 | 3 2 2 3 3 | 2 3 2 3 2 |
| | Co | 6 7 7 8 7 | 9 9 9 8 8 | 8 8 8 8 7 | 7 7 7 7 7 |
| | Pb | 5 6 5 6 4 | 5 6 6 5 5 | 4 4 5 5 5 | 5 5 5 4 4 |
| | Zn | 5 5 5 4 5 | 5 6 4 5 5 | 6 5 5 6 5 | 9 8 9 9 9 |
| B | Cu | 55 57 55 56 56 | 55 56 56 56 56 | 55 55 56 55 54 | 55 55 55 55 56 |
| | Ag | 78 78 78 78 79 | 77 77 77 77 78 | 77 78 77 77 78 | 77 77 77 78 76 |
| | Co | 44 44 44 44 45 | 44 44 45 45 44 | 43 43 44 43 43 | 42 42 42 42 42 |
| | Pb | 31 31 31 31 29 | 29 29 30 30 29 | 29 29 29 30 30 | 29 29 29 28 30 |
| | Zn | 123 123 121 123 123 | 128 127 130 129 128 | 126 125 125 128 126 | 128 125 129 127 128 |
| C | Cu | 110 110 111 110 111 | 110 110 108 110 108 | 111 109 110 110 110 | 109 109 110 109 109 |
| | Ag | 157 158 156 158 157 | 155 155 155 153 153 | 154 155 157 157 156 | 156 157 155 157 155 |
| | Co | 82 82 82 81 83 | 81 80 80 79 81 | 81 79 80 81 82 | 80 79 80 78 79 |
| | Pb | 56 55 55 55 55 | 53 53 53 54 53 | 54 54 53 53 53 | 54 54 52 55 54 |
| | Zn | 240 240 242 241 240 | 234 238 233 237 238 | 244 245 242 248 240 | 242 236 241 242 238 |

# NaOAc green

| | | SAN-027 | SAN-033 | SAN-041 | SAN-049 |
|---|---|---|---|---|---|
| A | Cu | 6 5 6 5 5 | 7 7 7 7 6 | 5 5 6 5 5 | 6 7 7 6 7 |
| | Ag | 2 3 2 2 2 | 1 1 1 1 1 | 0 0 1 0 1 | 1 1 1 1 1 |
| | Co | 8 7 7 7 7 | 7 6 7 7 6 | 5 6 6 6 5 | 6 7 7 7 7 |
| | Pb | 4 3 4 5 5 | 5 5 5 6 6 | 6 5 6 5 5 | 5 5 6 4 6 |
| | ZN | 12 13 12 12 13 | 115 115 116 114 114 | 25 26 26 25 26 | 26 25 26 26 26 |
| B | Cu | 64 61 63 63 63 | 64 64 64 65 64 | 62 63 64 64 63 | 064 064 064 064 065 |
| | Ag | 30 30 30 31 30 | 17 17 17 16 16 | 31 31 30 30 30 | 25 24 25 25 25 |
| | Co | 44 45 44 45 45 | 44 45 44 45 45 | 44 43 44 45 45 | 45 44 45 45 44 |
| | Pb | 30 30 30 29 30 | 30 31 31 30 31 | 32 31 30 31 31 | 31 31 31 30 30 |
| | ZN | 138 137 136 135 138 | 149 152 150 149 148 | 147 145 144 146 144 | 146 145 146 146 144 |
| C | Cu | 120 120 121 120 122 | 123 122 123 122 122 | 119 121 121 121 120 | 120 118 121 118 119 |
| | Ag | 32 33 33 34 33 | 34 34 35 35 34 | 53 52 55 53 53 | 30 29 30 29 30 |
| | Co | 85 85 83 83 84 | 84 83 82 ~~88~~ 85 | 83 83 85 84 83 | 83 83 85 83 84 |
| | Pb | 57 57 56 57 58 | 58 57 56 58 58 | 57 57 58 57 58 | 56 57 56 57 56 |
| | ZN | 253 257 255 256 252 | 265 265 267 265 265 | 263 262 264 265 264 | 262 260 263 264 264 |

# $NH_2OH$ blue

| | | SAN-027 | SAN-033 | SAN-041 | SAN-044 |
|---|---|---|---|---|---|
| A | Cu | 12 13 15 14 13 | 6 6 6 6 5 | 3 3 3 3 3 | 3 3 4 2 3 |
| | Ag | 1 0 1 1 1 | 0 0 0 0 0 | 0 0 0 0 0 | 0 0 0 0 0 |
| | Co | 18 18 17 17 17 | 4 3 3 3 4 | 3 3 3 3 2 | 2 3 3 3 3 |
| | Pb | ~~1 1 1 1 1~~ 6 5 5 4 4 | ~~0 0 0 0 0~~ 4 4 4 4 4 ~~2 2 2 2 2~~ | ~~0 0 0 0 0~~ 6 6 6 5 5 | ~~0 0 0 0 0~~ 4 4 3 3 3 |
| | Zn | 87 87 86 86 86 | 51 54 53 52 51 | 24 24 23 24 24 | 25 25 24 25 25 |
| B | Cu | 81 81 81 82 81 | 73 74 73 73 73 | 70 70 69 69 70 | 69 69 69 69 70 |
| | Ag | 36 35 35 35 36 | 25 26 25 25 25 | 32 32 32 31 32 | 18 18 18 18 18 |
| | Co | 62 62 63 62 62 | 47 48 48 48 48 | 47 47 47 48 47 | 47 47 48 47 47 |
| | Pb | ~~12 12 12 12 12~~ 31 33 34 33 33 | ~~11 11 11 11 11~~ 34 ~~35~~ 33 33 ~~30~~ 33 34 | ~~10 11 11 10 10~~ 34 34 34 35 35 | ~~10 10 10 10 10~~ 33 33 32 32 32 |
| | Zn | 228 226 227 233 226 | 194 193 194 193 194 | 170 171 166 167 164 | 169 168 166 165 166 |
| C | Cu | 149 149 151 149 148 | 140 140 140 141 140 | 137 135 141 137 139 | 137 136 140 138 140 |
| | Ag | 63 62 62 61 61 | 38 38 38 36 39 | 47 46 48 47 48 | 54 55 57 55 56 |
| | Co | 105 106 107 107 105 | 95 94 93 93 94 | 91 93 92 93 93 | 92 93 90 92 93 |
| | Pb | ~~23 24 23 24 24~~ 62 63 64 62 62 | ~~23 22 23 23 23~~ 65 ~~64~~ 64 ~~65 64~~ | ~~23 22 23 22 22~~ 67 67 67 65 65 | ~~21 22 22 21 22~~ 62 64 62 64 62 |
| | Zn | 362 364 362 361 362 | 328 334 325 331 326 | 304 312 307 311 306 | 302 304 301 304 303 |

$MgCl_2$ red

| | | SAN-027 | SAN-033 | SAN-041 | SAN-049 |
|---|---|---|---|---|---|
| A | Fe | 1 2 2 3 1 | 3 3 4 4 3 | 3 4 4 3 3 | 3 3 3 2 2 |
| | Mn | 3 3 5 3 3 | 2 2 1 2 2 | 1 2 2 2 0 | 0 2 0 2 2 |
| B | Fe | 49 50 48 51 48 | 48 49 48 51 49 | 48 49 47 49 50 | 49 48 47 49 47 |
| | Mn | 41 42 41 40 41 | 38 37 38 37 37 | 40 41 40 43 42 | 38 39 40 40 39 |
| C | Fe | 96 93 95 95 93 | 95 94 94 95 96 | 99 95 95 95 97 | 95 94 93 94 95 |
| | Mn | 78 78 77 77 79 | 76 78 76 78 76 | 76 78 77 76 77 | 77 77 77 78 78 |

NaO: ~~Spec~~

| | | SAN-027 | SAN-033 | SAN041 | SAN-044 |
|---|---|---|---|---|---|
| A | Fe | 3 0 2 0 0 | 0 0 0 0 1 | 0 0 0 0 1 | 1 0 0 0 0 |
| | Mn | 14 16 15 14 15 | 10 9 12 11 12 | 8 7 7 8 9 | 6 8 8 8 8 |
| B | Fe | 45 43 42 40 42 | 42 44 45 43 43 | 44 46 45 44 42 | 44 45 44 45 43 |
| | Mn | 52 52 52 55 51 | 48 47 48 49 47 | 46 47 45 46 47 | 47 47 47 48 48 |
| C | Fe | 83 81 84 84 82 | 86 87 89 85 88 | 90 90 89 93 90 | 88 89 86 89 86 |
| | Mn | 90 91 91 91 92 | 87 86 89 87 86 | 82 84 84 82 81 | 83 83 83 86 83 |

$NH_4OH$ blue

| | | SAN-027 | SAN-033 | SAN-041 | SAN-049 |
|---|---|---|---|---|---|
| A | Fe | 9 10 9<br>10 10 9 ~~13 12~~ | 29 30 31 30 29 | 25 24 23 24 23 | 25 25 24 24 23 |
| | Mn | 40 39 38 39 40 | 8 9 8 9 9 | 4 4 4 4 4 | 4 4 5 5 4 |
| B | Fe | ~~60 63 63 62 59~~<br>58 59 59 61 61 | 78 77 78 78 78 | 74 73 73 72 76 | 72 73 69 68 71 |
| | Mn | 79 78 78 80 81 | 49 48 47 48 47 | 42 43 42 43 43 | 41 41 45 43 43 |
| C | Fe | ~~109 107 108 109 109~~<br>108 109 107 109 110 | 126 127 128 127 127 | 118 122 122 123 121 | 121 117 118 120 119 |
| | Mn | 116 117 115 117 116 | 82 85 84 82 84 | 80 81 82 81 80 | 82 81 80 81 78 |

# $MgCl_2$ 28

| | | SAN-022 | SAN 029 | SAN-037 | SAN-045 |
|---|---|---|---|---|---|
| A | Cu | 2 3 2 2 2 | 3 3 3 3 3 | 3 2 2 3 2 | 3 2 3 2 2 |
| | Ag | 1 ~~1 1 0 0~~ 2 2 2 2 | 2 3 2 2 2 | 1 1 1 1 1 | 1 1 1 1 1 |
| | Co | 10 10 10 9 9 | 9 9 8 9 8 | 7 6 7 7 7 | 5 6 6 6 6 |
| | Pb | 2 3 2 2 1 | 4 4 4 4 4 | 3 3 3 3 2 | 1 1 1 1 2 |
| | Zn | 5 6 6 6 6 | 4 3 5 4 4 | 5 6 5 4 5 | 0 1 1 1 1 |
| B | Cu | 56 55 56 55 56 | 57 57 57 56 56 | 55 55 55 54 55 | 54 55 55 54 55 |
| | Ag | ~~71 70 71 70 70~~ 73 74 72 72 71 | 73 74 74 73 73 | 70 71 70 71 70 | 70 69 72 71 71 |
| | Co | 42 43 42 43 43 | 42 43 42 41 40 | 41 39 40 41 39 | 38 39 41 39 40 |
| | Pb | 24 25 24 25 25 | 27 27 26 27 26 | 25 25 25 25 24 | 24 25 24 23 23 |
| | Zn | 122 123 124 125 122 | 121 123 124 122 120 | 122 123 120 123 120 | 118 118 117 117 118 |
| C | Cu | 109 109 110 107 108 | 109 108 107 108 108 | 106 109 106 108 108 | 110 108 107 106 108 |
| | Ag | 140 144 142 140 141 ~~142 140 142 141 139~~ | 141 139 142 139 141 | 141, 142, 139, 142, 140 | 142 143 142 138 139 |
| | Co | 76 77 76 75 76 | 74 75 74 75 71 | 74 72 73 73 73 | 73 74 76 73 74 |
| | Pb | 48 51 50 49 49 | 48 48 49 50 48 | 47 47 47 48 46 | 46 46 48 46 46 |
| | Zn | 241 242 242 241 242 | 229 230 227 234 233 | 224 225 225 225 225 | 226 225 223 223 224 |

MgCl2 (ne)

| | | SAN 024 | SAN 031 | SAN 039 | San 047 |
|---|---|---|---|---|---|
| A | Cu | ~~4 5 3 5 4~~<br>3 2 3 3 3 | 2 2 2 2 2 | 1 1 1 1 1 | 2 2 2 2 2 |
| | Ag | 2 1 1 1 1 | 2 2 1 1 1 | ~~2 1 1 1 1 1~~<br>~~7 8 7 7 7~~ | 1 1 1 1 1 |
| | Co | 7 7 7 8 8 | 6 5 6 6 6 | ~~10 10 9 10 9~~ | 6 6 7 7 6 |
| | Pb | 6 7 6 6 6 | 3 3 2 4 4 | 3 5 5 5 4 | ~~12 12 12 12 12~~ |
| | ZN | 1 1 1 2 1 | 3 2 2 2 2<br>~~1 1 0 1 1~~ | 1 1 1 1 1 | 4 4 4 3 3<br>0 1 1 1 1 |
| B | Cu | ~~59 60 59 60 59~~<br>59 58 58 57 57 | 56 58 56 57 56 | 55 55 55 55 56 | 56 57 56 57 56 |
| | Ag | 73 72 71 72 72 | 72 72 73 72 72 | 72 72 71 71 71 | 71 72 71 71 71 |
| | Co | 43 43 43 44 43 | 38 39 39 39 39 | 38 37 37 38 38<br>~~43 44 44 43 43~~ | 38 38 38 37 37<br>~~43 43 45 44 44~~ |
| | Pb | 30 30 29 29 28 | 26 28 27 28 26 | 28 28 28 27 27 | 27 27 27 27 28 |
| | ZN | 119 118 118 117 119 | ~~117 116 119 119 120~~<br>117 117 116 118 119 | 121 121 119 120 119 | 131 130 128 129 131 |
| C | Cu | ~~117 116 114 118 117~~<br>114 116 116 114 113 | 114 112 111 112 111 | 112 111 112 112 113 | 112 113 112 112 112 |
| | Ag | 141 144 144 144 142 | 145 145 144 144 144 | 144 144 144 144 142 | 143 142 142 141 143 |
| | Co | 76 76 76 75 76 | 74 74 74 73 74 | ~~78 78 76 78 78~~<br>69 69 70 70 69 | ~~78 79 77 78 78~~<br>71 72 69 69 69 |
| | Pb | 52 51 53 51 51 | 51 53 51 52 53 | 53 53 52 51 51 | 51 51 50 51 51 |
| | ZN | 235 233 237 231 235 | 231 232 231 234 230 | 231 234 229 232 232 | 227 226 227 230 231 |

# $MgCl_2$ (red)

| | | SAN 022 | SAN029 | SAN 037 | SAN045 |
|---|---|---|---|---|---|
| A | Fe | ~~1~~ 0 0 1 2 2 2 | 2 1 1 3 1 | 4 2 4 5 4 | 3 3 6 4 2 |
| | MN | ~~10 10 10 11 11~~ | ~~1 0 1 1 1~~ | ~~0 0 0 1 0~~ | 4 4 3 2 3 |
| | SN | 13 14 15 13 15 | 6 5 6 7 8 | 4 6 5 6 6 | ~~0 0 0 0 0~~ |
| B | Fe | 43 47 47 44 47 | 47 46 45 47 47 | 49 49 51 49 51 | 44 47 47 46 44 |
| | MN | ~~57 55 57 59 57~~ | ~~45 45 46 45 47~~ | ~~44 43 44 44 43~~ | 49 48 49 50 50 |
| | SN | 60 60 60 61 61 | 52 53 53 55 52 | 51 49 49 51 49 | |
| C | Fe | 89 89 90 90 88 | 92 91 90 90 91 | 93 94 93 94 95 | 91 91 92 96 90 |
| | MN | ~~105 105 104 107 106~~ | ~~90 94 90 91 91~~ | ~~89 89 90 90 87~~ | 94 97 97 96 94 |
| | SN | 107 109 108 107 105 | 98 99 99 98 98 | 96 96 96 99 98 | |

NaOAc (s)

| | | SAN 024 | SAN 031 | SAN 039 | SAN 047 |
|---|---|---|---|---|---|
| A | Cu | 6 6 7 7 7 | 10 9 9 9 9 | 9 7 9 8 8 | 7 7 7 7 7 |
| | Ag | 1 1 1 1 1 | 1 1 1 1 1 | 1 1 1 1 1 | 1 1 1 1 1 |
| | Co | 14 14 15 14 14 | 15 15 15 15 15<br>~~13 13 13 13 14~~ | 5 6 5 5 6<br>~~3 4 4 4 4~~ | 4 4 4 4 4<br>~~0 1 1 1 1~~ |
| | Pb | 4 3 4 4 4 | 3 3 3 3 3 | 3 3 3 3 3 | 2 2 2 1 1<br>~~3 3 1 1 2~~ |
| | Zn | 15 16 15 15 15 | 11 10 10 10 10 | 23 23 23 23 23 | 25 25 25 24 26 |
| B | Cu | 65 65 65 64 63 | 68 67 68 68 68 | 64 64 64 64 65 | 64 63 63 64 63 |
| | Ag | 66 69 67 66 67 | 67 67 67 66 68 | 63 65 64 64 64 | 67 66 66 66 66 |
| | Co | 47 47 48 47 47 | 49 ~~47~~ 49 ~~47 47~~ 50 50 | 40 40 40 40 39<br>~~37 37 37 37 37~~ | 37 38 37 37 38<br>~~34 35 34 35 35~~ |
| | Pb | 27 27 27 27 27 | 25 26 25 26 27 | 30 28 29 29 29 | 25 25 25 25 25 |
| | Zn | 136 135 138 135 137 | 132 134 134 135 135 | 145 147 145 143 142 | 147 146 147 147 145 |
| C | Cu | 122 121 122 124 125 | 125 125 126 125 126 | 123 123 123 123 122 | 121 222 120 123 122 |
| | Ag | 129 130 128 131 130 | 135 134 134 134 132 | 130 131 130 129 130 | 131 132 131 130 133 |
| | Co | 83<br>~~79~~ 81 82 ~~79~~ 82 | ~~82 81 84 82 82~~<br>85 84 85 85 84 | ~~72 70 71 71 71~~<br>74 74 74 76 74 | 75 74 73 72 72<br>~~69 71 69 68 69~~ |
| | Pb | 51 51 51 52 52 | 49 50 50 50 51 | 51 52 51 52 52 | 49 50 49 49 50 |
| | Zn | 253 252 ~~250~~ 252 253 | 250 247 246 248 250 | 255 254 261 ~~255~~ 257 | 258 260 262 260 260 |

# NaOAc green

| | | SAN-022 | SAN-029 | SAN037 | SAN045 |
|---|---|---|---|---|---|
| A | Cu | 4 4 5 5 4 | 6 7 6 6 6 | 6 6 6 6 6 | 7 6 7 5 6 |
| | Ag | 2 2 1 1 1 | 0 1 0 1 0 | 0 0 0 0 0 | 0 0 0 0 0 |
| | Co | 14 12 14 13 13 | 6 7 7 7 7 | 7 6 6 6 5 | 6 7 7 7 7 |
| | Pb | 3 3 3 4 3 | 3 3 3 3 3 | 3 3 3 3 3 | 3 3 3 3 3 |
| | Zn | 19 19 19 19 19 | 23 22 23 22 22 | 29 29 29 28 29 | 38 37 37 37 37 |
| B | Cu | 59 61 61 60 61 | 60 61 60 61 61 | 61 62 61 62 62 | 61 61 60 62 62 |
| | Ag | 63 62 63 62 61 | 62 62 63 62 64 | 61 60 60 62 61 | 60 59 61 58 60 |
| | Co | 47 48 48 49 48 | 42 42 43 41 42 | 41 42 41 41 42 | 43 42 41 41 42 |
| | Pb | 25 26 25 27 25 | 25 25 25 25 25 | 25 25 25 26 25 | 26 26 25 26 25 |
| | Zn | 137 138 140 138 138 | 138 137 137 140 141 | 151 152 154 151 153 | 152 151 151 155 156 |
| C | Cu | 116 115 118 115 114 | 119 118 118 118 118 | 117 115 116 118 117 | 116 116 116 118 118 |
| | Ag | 121 117 116 114 118 | 123 122 121 122 119 | 121 123 121 125 122 | 120 120 118 120 119 |
| | Co | 83 81 85 82 85 | 78 78 79 80 77 | 79 77 78 77 80 | 79 78 78 77 76 |
| | Pb | 49 49 51 50 51 | 49 48 50 50 49 | 49 50 50 50 50 | 49 50 49 49 48 |
| | Zn | 251 247 250 249 250 | 250 252 253 255 252 | 251 255 254 252 255 | 268 266 264 264 266 |

.0068
.0042
.7784

NaOAc (grind)

| | | SAN-022 | SAN025 | SAN037 | SAN045 |
|---|---|---|---|---|---|
| A | Fe | 0 1 1 0 0 | 0 0 0 1 0 | 4 4 4 4 3 | 9 9 9 10 9 |
| | MN | 21 21 21 21 22 | 11 11 11 11 10 | 7 7 7 7 7 | ~~7 6 6 7 5~~ |
| | SN | | | | 11 10 10 11 12 |
| B | Fe | 38 41 39 38 40 | 40 37 40 40 40 | 46 48 51 47 47 | 51 52 52 51 53 |
| | MN | 68 67 65 66 67 | 59 58 59 59 59 | 52 53 52 53 51 | ~~51 50 52 52 52~~ |
| | SN | | | | 57 57 56 56 56 |
| C | Fe | 83 81 81 78 80 | 81 82 80 80 80 | 93 92 93 92 94 | 99 95 99 95 98 |
| | MN | 111 111 112 113 110 | 100 104 103 102 103 | 97 99 100 98 99 | ~~104 105 102 105 105~~ |
| | SN | | | | 107 109 110 109 111 |

$NH_2OH$ blue

| | | SAN022 | SAN029 | SAN037 | SAN045 |
|---|---|---|---|---|---|
| A | Cu | 6 7 6 6 6 | 5 5 4 5 5 | 4 3 3 3 3 | 3 2 3 3 3 |
| | Ag | 1 0 2 1 1 | 1 1 1 0 1 | 0 0 0 0 0 | 0 1 0 0 1 |
| | Co | 23 22 23 24 23 | 5 5 5 4 5 | 3 4 4 3 4 | 4 4 3 4 3 |
| | Pb | 1 1 1 1 2 | 1 1 1 1 1 | 1 1 1 2 1 | 1 1 1 1 1 |
| | Zn | 96 95 95 97 95 | 45 45 45 45 44 | 22 21 20 22 22 | 33 33 33 33 32 |
| B | Cu | 72 71 71 72 71 | 69 69 70 70 70 | 65 68 67 67 67 | 67 68 68 67 68 |
| | Ag | 73 74 76 73 73 | 72 71 71 73 72 | 72 71 72 74 73 | 72 71 73 72 74 |
| | Co | 65 63 65 64 63 | 45 46 45 46 47 | 46 45 44 46 46 | 44 45 45 44 46 |
| | Pb | 29 28 28 28 28 | 27 27 27 27 28 | 27 27 28 28 28 | 27 28 28 28 28 |
| | Zn | 229 230 226 229 228 | 180 177 181 181 181 | 158 156 153 158 157 | 171 168 170 170 171 |
| C | Cu | 139 137 136 137 139 | 138 135 136 135 137 | 133 134 134 134 133 | 134 134 134 133 133 |
| | Ag | 146 148 147 146 148 | 142 144 146 144 143 | 146 144 143 146 145 | 146 141 148 147 148 |
| | Co | 102 107 104 103 105 | 87 89 87 88 85 | 89 88 89 91 90 | 88 86 85 89 87 |
| | Pb | 55 56 56 56 56 | 55 55 54 56 55 | 56 56 57 56 57 | 56 56 57 56 56 |
| | Zn | 349 352 354 354 353 | 318 301 311 311 310 | 288 288 291 285 291 | 293 293 293 294 294 |

$NH_2OH$ blue

| | | SAN024 | SAN031 | SAN039 | SAN047 |
|---|---|---|---|---|---|
| A | Cu | 7 7 7 8 9 | 9 9 8 9 8 | 2 2 2 2 2 | 2 2 1 1 1 |
| | Ag | 1 1 1 1 1 | 2 2 2 2 2 | 3 3 3 3 3 | 3 3 3 3 3 |
| | Co | 24 24 24 24 24 | 8 8 8 8 8 | ~~0 0 0 0 0~~ 1 1 1 2 2 | 2 2 2 2 1 ~~0 0 0 0 0~~ |
| | Pb | 4 5 4 4 4 | 3 3 3 3 3 | 3 2 2 2 2 | 2 3 3 3 3 |
| | ZN | 109 109 112 108 108 | 77 78 79 78 79 | 28 29 27 27 27 | 27 26 26 27 27 |
| B | Cu | 73 75 75 74 73 | 73 74 74 74 74 | 69 69 69 68 68 | 67 69 68 69 68 |
| | Ag | 77 79 77 77 78 | 79 78 78 79 78 | 78 80 80 78 79 | 76 79 77 78 78 |
| | Co | 63 63 62 61 63 | 47 46 46 45 46 | ~~59 39 39 39 40~~ 43 43 43 43 44 | 41 42 42 42 42 ~~40 39 40 40 40~~ |
| | Pb | 31 32 32 32 32 | 30 30 31 31 31 | 29 29 30 30 29 | 31 30 32 30 30 |
| | ZN | 239 237 241 242 244 | 232 230 230 230 225 | 168 168 170 170 169 | 167 170 167 171 170 |
| C | Cu | 142 142 142 140 139 | 143 142 139 142 144 | 135 139 136 136 135 | 135 137 136 137 139 |
| | Ag | 151 151 154 149 151 | 154 155 153 155 155 | 156 151 153 152 154 | 151 148 151 150 152 |
| | Co | 102 102 102 100 101 | 84 85 85 85 83 | ~~80 79 80 80 80~~ 84 85 85 85 85 | 86 85 84 84 84 ~~80 80 80 80 81~~ |
| | Pb | 60 61 61 61 61 | 60 60 60 59 59 | 58 60 59 61 59 | 59 60 59 55 60 |
| | ZN | 376 373 375 378 375 | 348 348 353 346 350 | 299 301 302 300 305 | 304 306 306 303 304 |

$NH_4OH$ 6he

| | | SAN022 | SAN029 | SAN037 | SAN045 |
|---|---|---|---|---|---|
| A | Fe | 11 15 15 13 16 | 25 24 24 23 24 | 14 12 12 12 11 | 15 14 14 16 16 |
| | Mn | 58 57 57 59 58 | 12 12 12 12 12 | 9 9 11 11 11 | 11 10 10 10 11 |
| | Sn | | | | |
| B | Fe | 58 57 56 57 57 | 65 67 68 68 67 | 58 56 57 57 56 | 60 59 58 58 57 |
| | Mn | 104 105 104 105 103 | 58 59 58 59 58 | 55 57 58 58 56 | 56 57 56 55 55 |
| | Sn | | | | |
| C | Fe | 104 100 99 100 104 | 114 112 109 111 112 | 95 97 99 96 98 | 103 102 104 101 102 |
| | Mn | 151 149 146 148 148 | 103 107 106 103 107 | 98 98 100 100 98 | 102 99 101 102 100 |
| | Sn | | | | |

# $MgCl_2$ wb

| | | SAN-024 | SAN-031 | SAN-039 | SAN-047 |
|---|---|---|---|---|---|
| A | Fe | ~~3 2 6 3 3~~ 2 1 2 2 2 | 0 0 0 1 0 | 1 1 0 3 0 | 0 1 2 0 1 |
| | Mn | 25 25 25 26 27 | 3 4 3 5 3 | 2 1 0 2 3 | 3 3 3 4 4 |
| B | Fe | 47 46 47 45 48 | 48 45 44 47 42 | 46 43 45 44 48 | 47 44 45 47 48 |
| | Mn | 75 75 75 75 74 | 52 53 51 53 53 | 51 52 52 52 53 | 55 53 54 53 52 |
| C | Fe | 94 91 93 90 93 | 89 91 90 87 88 | 92 91 89 88 88 | 86 92 91 91 86 |
| | Mn | 125 124 124 122 124 | 103 102 102 101 98 | 99 101 101 101 99 | 100 102 103 100 102 |

NaOAc ~~green~~

| | | SAN-024 | SAN-031 | SAN-039 | SAN-047 |
|---|---|---|---|---|---|
| A | Fe | 1 2 0 2 0 | 2 2 3 2 2 | 5 5 4 6 7 | 3 3 5 4 0 |
| | Mn | 28 30 29 29 29 | ~~16 16 15 19 17~~ 14 14 14 14 13 | 11 12 10 10 10 | 8 9 8 8 7 |
| B | Fe | 45 42 45 43 43 | 43 46 45 45 45 | 50 51 51 50 52 | 47 46 47 44 42 |
| | Mn | 78 79 79 79 80 | ~~66 68 68 68 67~~ 62 63 62 61 62 | 61 61 59 60 60 | 57 57 58 57 56 |
| C | Fe | 87 87 83 86 86 | 85 86 82 86 86 | 94 89 91 92 92 | 83 86 86 90 83 |
| | Mn | 129 125 127 125 127 | ~~115 116 115 117 117~~ 109 110 109 109 109 | 109 109 107 106 108 | 108 107 106 106 107 |

$NH_2OH$ blue

| | | SAN024 | SAN031 | SAN039 | SAN-047 |
|---|---|---|---|---|---|
| A | Fe | 10 10 10 11 11 | 14 10 13 15 11 | 24 22 19 21 20 | 18 19 17 21 21 |
| | Mn | 40 42 41 41 41 | 18 19 17 17 19 | 6 6 5 5 5 | 3 3 4 3 3 |
| B | Fe | 57 38 55 55 58 | 59 60 59 59 57 | 67 67 65 68 65 | 68 64 65 65 65 |
| | Mn | 92 92 92 92 93 | 68 68 69 68 69 | 54 54 54 55 54 | 54 52 53 53 52 |
| C | Fe | 100 101 101 97 105 | 103 103 104 103 104 | 108 107 110 106 108 | 113 113 113 109 108 |
| | Mn | 139 138 140 139 140 | 115 116 116 117 116 | 97 99 100 99 99 | 102 100 100 101 102 |

# $MgCl_2$ vol

| | | SAN-025 | SAN-032 | SAN-040 | SAN-048 |
|---|---|---|---|---|---|
| A | Cu | ~~4 5 4 5 5~~ | 3 3 3 2 3 | 2 2 1 1 1 | 2 3 2 2 2 |
| | Ag | 3 3 3 4 4 | 4 3 3 3 3 | 3 3 3 3 3 | 5 5 4 5 4 |
| | Co | 3 3 2 3 2 | 10 10 10 9 9 | 10 10 10 10 10 | 10 10 10 10 9 |
| | Pb | ~~15 12 11 10 8~~ | 6 6 6 6 5 | 8 8 8 8 7 | 6 5 6 5 3 |
| | ZN | 13 12 12 12 13 | 6 6 5 5 5 | 5 5 5 4 4 | |
| | | 8 7 6 7 7 | | ~~6 7 6 6 6~~ | 5 5 5 4 4 |
| | | 8 8 8 7 6 | | | |
| B | Cu | 56 57 57 58 57 | ~~58 59 58 58 58~~ | | |
| | Ag | ~~61 61 61 61 61~~ | 57 57 57 57 56 | 53 55 53 54 53 | 55 55 56 54 55 |
| | Co | 71 73 72 73 72 | 71 72 73 72 70 | 70 70 71 70 71 | 71 72 71 72 72 |
| | Pb | 43 44 44 45 45 | 40 40 40 40 40 | 41 42 41 41 41 | 41 41 41 40 40 |
| | ZN | ~~32~~ 30 29 31 31 | 28 28 28 28 28 | 30 30 31 30 30 | 25 25 25 24 24 |
| | | 125 125 124 127 126 | 124 121 ~~120~~ 121 123 | 120 119 120 120 119 | |
| | | | | ~~124 126 126 126 125~~ | 121 120 120 120 120 |
| C | Cu | ~~117 118 116 116 117~~ | ~~110 110 111 110 110~~ | 105 107 ~~107 107~~ 105 | 106 105 105 105 105 |
| | | 108 110 109 111 109 | 109 109 108 110 109 | | |
| | Ag | 141 138 141 139 141 | 141 143 140 141 140 | 141 139 141 140 142 | ~~140 139 141 140 139~~ |
| | Co | 76 76 76 76 75 | 73 73 71 70 72 | 73 72 73 73 73 | 70 69 70 69 69 |
| | Pb | 54 54 54 52 55 | 52 52 51 51 51 | 54 55 54 55 54 | 45 48 45 46 47 |
| | ZN | 241 ~~238~~ 241 235 240 | 235 232 233 235 231 | 226 227 229 224 230 ~~236 236 235 235 235~~ | 226 229 227 225 224 |

NaOAc gre

| | | SAN025 | SAN032 | SAN040 | SAN048 |
|---|---|---|---|---|---|
| A | Cu | 4 4 5 4 5 | 5 5 4 4 4 | 5 5 4 5 4 | 3 2 3 3 3 |
| | Ag | 2 2 2 2 2 | 1 1 1 1 1 | 2 1 2 1 2 | 2 2 2 2 2 |
| | Co | 20 21 20 20 20 | 11 12 12 11 12 | 2 3 3 3 3 | ~~3 3 3 2 3~~ |
| | Pb | 6 6 6 6 6 | 6 7 6 4 4 | 7 8 7 7 7 | 7 7 7 7 7 |
| | Zn | 20 20 20 20 21 | 25 25 25 24 25 | 5 3 3 3 4 | 7 7 7 7 7 |
| | | | | 24 24 24 25 25 | 24 24 24 24 24 |
| B | Cu | 58 58 59 59 59 | 58 58 59 60 59 | 60 60 60 61 59 | 58 57 59 59 59 |
| | Ag | 61 62 60 60 61 | 58 59 58 60 60 | 63 63 62 64 62 | 63 62 62 63 62 |
| | Co | 53 53 54 54 54 | 46 46 46 46 46 | 41 42 41 42 42 | 40 40 40 39 40 |
| | Pb | 27 29 29 29 29 | 27 29 28 27 28 | 27 27 28 29 27 | 31 31 31 31 31 |
| | Zn | 141 141 143 141 141 | 144 145 145 146 146 | 146 145 146 147 145 | 147 147 149 145 144 |
| C | Cu | 114 115 112 113 113 | 114 115 113 114 112 | 117 117 116 117 116 | 116 116 115 114 117 |
| | Ag | 119 117 119 116 117 | 117 118 119 118 117 | 124 123 ~~118 119~~ 120 120 119 | 118 119 117 121 118 |
| | Co | 89 90 98 89 90 | 81 82 83 81 82 | 76 75 76 77 76 | 74 72 73 74 73 |
| | Pb | 54 54 54 55 54 | 51 53 52 52 49 | 51 52 52 52 52 | 57 57 56 58 58 |
| | Zn | 252 256 256 253 257 | 259 257 262 264 260 | 258 257 259 253 257 | 257 259 257 257 259 |

$NH_2OH$ 6k

| | | SAW025 | SAW032 | SAW040 | SAW048 |
|---|---|---|---|---|---|
| A | Cu | 5 7 7 7 7 | 3 4 3 4 3 | 2 2 3 3 3 | 1 2 2 2 2 |
| | Ag | 0 0 0 0 0 | 0 0 0 0 0 | 0 0 0 0 0 | 0 0 0 0 0 |
| | Co | 26 26 26 26 27 | 3 2 3 2 2 | 2 2 1 2 1 | 1 2 2 2 1 |
| | Pb | 5 5 5 5 5 | 5 5 5 5 5 | 5 5 5 5 5 | 5 5 4 4 4 |
| | Zn | 111 109 111 109 111 | 28 27 28 29 28 | 20 19 19 19 18 | 16 17 17 17 17 |
| B | Cu | 71 72 72 72 72 | 68 68 68 68 69 | ~~69 71 70 72 70~~ 69 69 69 70 69 | 67 66 67 66 67 |
| | Ag | 75 76 77 76 77 | 73 73 73 73 72 | 71 72 72 72 72 | 66 66 65 65 64 |
| | Co | 65 66 65 65 65 | 42 43 42 42 43 | 40 42 42 42 41 | 42 42 42 41 42 |
| | Pb | 34 33 32 34 34 | 34 33 32 33 34 | 33 33 34 33 33 | 32 32 32 32 32 |
| | Zn | 248 247 250 248 246 | 170 169 172 168 167 | 156 155 157 158 158 | 156 158 157 157 157 |
| C | Cu | 138 138 139 139 138 | 135 134 138 134 136 | ~~140 140 137 142 138~~ 137 135 135 135 135 | 132 131 133 132 132 |
| | Ag | 152 152 151 149 149 | 148 148 147 144 145 | 140 140 141 138 141 | ~~138~~ 133 129 129 129 129 129 |
| | Co | 106 105 107 106 106 | 84 85 83 82 83 | 82 82 83 82 82 | 82 81 80 81 81 |
| | Pb | 62 62 62 61 62 | 62 62 62 62 62 | 61 61 60 62 62 | 60 60 60 60 59 |
| | Zn | 371 373 374 371 373 | 302 306 307 297 298 | 283 287 283 286 286 | 284 290 286 286 289 |

$MgCl_2$ red

| | | SAN025 | SAN032 | SAN040 | SAN048 |
|---|---|---|---|---|---|
| A | Fe | 1 0 0 0 0 | 0 0 1 0 0 | 3 2 0 1 3 | 1 2 3 0 0 |
| | Mn | 23 24 23 22 22 | 6 5 5 5 4 | 3 3 3 3 3 | 4 5 6 6 6 |
| B | Fe | 49 50 44 48 54 | 51 51 51 49 48 | 49 48 50 48 46 | 46 46 46 46 45 |
| | Mn | 73 74 73 74 74 | 58 56 56 56 57 | 55 55 55 54 54 | 59 56 55 56 58 |
| C | Fe | 95 93 92 95 93 | 95 96 92 92 93 | 97 92 93 97 99 | 96 95 94 95 ~~90~~ |
| | Mn | 123 125 125 123 123 | 108 107 108 107 109 | 105 105 106 107 108 | 109 108 109 110 109 |

NaOAc [illegible]

~~$NH_2OH$ [illegible]~~

| | | SAN025 | SAN032 | SAN040 | SAN048 |
|---|---|---|---|---|---|
| A | Fe | ~~1 0 1 0 0~~ 5 3 5 0 4 | 5 5 4 7 2 | 9 ~~8 8 8~~ 7 7 7 6 | 12 11 15 10 10 |
| | MN | 25 26 25 24 24 | 11 11 12 13 11 | 7 8 8 6 7 | 7 8 8 9 9 |
| B | Fe | 43 44 40 44 42 | 41 37 42 42 41 | 49 46 45 49 47 | 59 58 56 58 58 |
| | MN | 75 74 77 77 75 | 64 64 63 63 63 | 60 60 58 60 58 | 60 62 61 61 58 |
| C | Fe | 84 89 83 88 85 | 83 82 83 83 83 | 90 92 92 89 90 | 95 99 98 94 97 |
| | MN | 127 125 126 127 127 | 115 116 118 115 115 | 111 110 111 109 109 | 111 111 108 109 110 |

$NH_2OH$ 1w

~~NaOAc~~ ~~green~~

| | | SAN025 | SAN032 | SAN040 | SAN048 |
|---|---|---|---|---|---|
| A | Fe | ~~3 4 5 3 3~~<br>12 13 13 16 15 | ~~2 4 0 3 5~~<br>23 21 22 22 23 19 | ~~9 5 6 10 8~~<br>25 21 23 22 22 23 | ~~16 13 12 13 14~~<br>22 20 23 21 21 |
| | Mn | ~~25 26 25 24 24~~<br>39 39 39 39 39 | ~~14 14 14 14 14~~<br>~~11 11 12 13 11~~<br>2 3 4 3 4 | ~~7 8 8 6 7~~<br>2 2 2 2 3 | ~~7 8 8 9 9~~<br>3 3 2 3 2 |
| B | Fe | ~~43 46 44 46 44~~<br>62 61 63 62 62 | ~~44 44 45 46 42~~<br>68 69 70 70 68 | ~~48 54 51 47 50~~<br>72 70 74 71 71 | ~~54 54 57 58 60~~<br>69 71 70 69 71 |
| | Mn | ~~75 74 77 77 75~~<br>92 92 92 93 92 | ~~64 64 63 63 63~~<br>57 55 56 55 57 | ~~60 60 58 60 58~~<br>55 56 56 56 55 | ~~60 62 61 61 58~~<br>58 57 56 56 56 |
| C | Fe | ~~89 90 93 89 89~~<br>109 114 113 111 110 | ~~86 88 88 88 86~~<br>119 115 118 119 114 | ~~97 94 96 90 93~~<br>122 122 119 117 119 | ~~102 104 99 102 102~~<br>121 115 116 116 120 |
| | Mn | ~~127 125 126 127 127~~<br>141 143 142 142 141 | ~~115 116 118 115 115~~<br>105 105 107 105 107 | ~~111 110 111 109 109~~<br>106 105 104 105 106 | ~~111 111 108 109 110~~<br>105 107 107 107 107 |

# $MgCl_2$ red

| | | SAN-021 | SAN-028 | SAN-036 | SAN-044 |
|---|---|---|---|---|---|
| A | Cu | 4 4 3 3 3 | 3 5 4 4 4 | 4 4 3 4 4 | ~~2 3 2 3 3~~ ~~1 0 0 0~~ |
| | Ag | 5 4 4 4 4 | 4 4 4 4 4 | 4 4 4 4 4 | 5 5 4 4 4 |
| | Co | 10 10 11 10 11 | 9 9 9 9 9 | 13 13 14 13 12 | 11 10 11 10 10 |
| | Pb | ~~8 6 8 8 7~~ 8 8 9 8 9 | 7 8 9 8 8 | 9 11 10 11 9 | 8 8 7 8 7 |
| | ZN | 8 7 7 7 7 | 6 8 7 7 7 | 8 8 8 8 8 | 7 8 6 7 6 |
| B | Cu | 60 60 60 59 59 | 60 60 59 59 59 | 58 58 58 58 57 57 | 58 59 58 58 58 |
| | Ag | 79 79 79 78 78 | 78 77 77 77 77 | 79 78 78 78 78 | 78 78 78 78 78 |
| | Co | 45 46 45 45 46 | 42 42 44 44 42 | 47 46 47 47 47 | 44 44 43 44 43 |
| | Pb | 33 33 32 33 31 | 31 32 32 32 32 | 33 35 32 34 33 | 33 32 34 32 31 |
| | ZN | 129 130 128 128 129 | 128 127 127 127 127 | 128 129 129 128 130 | 128 128 127 127 126 |
| C | Cu | 114 114 114 114 113 | 114 112 112 113 113 | 113 112 110 112 110 | 112 112 112 113 113 |
| | Ag | 152 152 153 152 151 | 152 151 151 150 150 | 153 153 153 153 152 | 151 150 151 151 151 |
| | Co | 79 79 79 79 79 | 75 77 75 77 76 | 80 79 80 80 80 | 79 77 78 78 78 |
| | Pb | 56 55 54 54 55 | 55 55 54 55 55 | 57 57 58 59 58 | 56 58 57 57 56 |
| | ZN | 243 244 241 242 242 | 240 240 240 240 240 | 244 244 245 243 245 | 242 243 241 242 241 |

NaOAc green

| | | SAW-021 | SAW-028 | SAW-036 | SAW-044 |
|---|---|---|---|---|---|
| A | Cu | 5 5 5 5 5 | 12 11 12 10 11 | 7 7 7 7 7 | 5 6 6 5 5 ~~7 8 8 8 8~~ |
| | Ag | 4 4 4 4 4 | 3 3 3 3 3 | 3 4 3 3 3 | 3 3 3 3 3 |
| | Co | 11 11 11 11 11 | 11 10 11 10 10 | 11 11 10 10 10 | 11 11 11 11 11 |
| | Pb | 8 8 7 7 8 | 8 7 9 8 8 | 7 7 7 7 6 | 8 7 8 8 8 |
| | Zn | 20 20 20 20 20 | 18 18 18 17 16 | 26 26 26 25 25 | 25 27 26 26 26 |
| B | Cu | 62 62 63 61 61 | 70 70 70 69 69 | 65 65 65 65 65 | 63 62 62 63 63 ~~67 67 66 67 68~~ |
| | Ag | 64 65 65 65 64 | 67 67 67 67 67 | 65 66 66 66 66 | 65 65 65 65 65 |
| | Co | 45 45 45 45 44 | 45 45 45 44 44 | 46 45 45 45 45 | 46 46 46 46 46 |
| | Pb | 31 32 30 32 31 | 34 33 33 33 35 | 33 31 32 34 31 | 33 34 33 34 33 |
| | Zn | 147 146 145 145 144 | 142 143 143 140 141 | 151 151 151 150 149 | 153 153 150 151 150 |
| C | Cu | 118 118 117 115 117 | 128 129 128 129 127 | 125 125 124 124 124 | ~~125 125 126 125 126~~ 120 119 119 120 118 |
| | Ag | 127 126 125 125 126 | 132 131 132 131 132 | 128 130 128 125 127 | 126 127 125 126 125 |
| | Co | 78 77 78 77 78 | 79 78 79 77 78 | 79 81 79 80 79 | 81 80 81 80 81 |
| | Pb | 56 56 58 56 56 | 59 59 61 60 61 | 60 60 60 59 59 | 60 58 60 58 62 |
| | Zn | 262 264 263 264 267 | 261 262 262 25 261 | 269 267 267 266 266 | 272 269 268 268 270 |

$NH_2OH$ blue

| | | SAN-021 | SAN-028 | SAN-036 | SAN-044 |
|---|---|---|---|---|---|
| A | Cu | 8 8 8 8 7 | 9 8 8 8 7 | 3 3 3 3 4 | 3 3 3 3 3 |
| | Ag | 0 0 0 0 0 | 0 0 0 0 0 | 0 0 0 1 0 | 0 0 0 0 1 |
| | Co | 19 19 19 18 18 | 6 7 6 6 6 | 5 5 5 5 6 | 5 4 5 5 4 |
| | Pb | 10 10 10 10 10 | 9 ~~8 8 8~~ 9 (9 9 9) | 8 9 8 9 (9) | 10 9 9 9 10 |
| | Zn | 91 90 90 90 90 | 58 58 57 57 57 | 28 28 29 28 28 | 25 26 26 26 25 |
| B | Cu | 80 79 82 81 80 | 75 76 75 75 75 | 71 70 70 70 72 | 71 71 69 71 70 |
| | Ag | 76 76 77 77 76 | 77 77 77 76 76 | 74 73 74 73 73 | 76 76 76 78 75 |
| | Co | 61 60 60 59 60 | 48 49 49 49 48 | 47 45 46 46 46 | 47 47 46 46 47 |
| | Pb | 40 41 40 41 39 | ~~37 38 38 38 36~~ (40 39 40 39 39) | 37 39 39 39 37 | 39 39 38 39 38 |
| | Zn | 263 262 260 262 263 | 203 203 202 200 200 | 172 175 174 172 173 | 172 174 173 172 170 |
| C | Cu | 145 146 144 144 144 | 142 142 143 142 142 | 139 139 139 140 138 | 139 140 138 138 140 |
| | Ag | 157 158 159 157 156 | 157 158 160 158 158 | 153 151 151 149 148 | 150 150 148 149 150 |
| | Co | 101 101 101 101 101 | 89 90 89 89 88 | 88 88 88 88 87 | 90 89 89 89 90 |
| | Pb | 69 68 70 68 69 | ~~67 66 66 66 66~~ (70 70 71 71 71) | 69 68 68 70 67 | 71 70 70 70 70 |
| | Zn | 370 370 367 369 365 | 336 339 337 339 339 | 314 311 313 311 312 | 307 310 309 309 310 |

MgCl2 red

| | | SAN021 | SAN028 | SAN036 | SAN044 |
|---|---|---|---|---|---|
| A | Fe | 3 3 3 2 4 | 2 2 1 0 0 | 2 0 3 1 0<br>~~0 0 0 0 0~~ | 3 1 2 1 0<br>~~4 5 5 5 4~~ |
| | Mn | 7 8 7 6 7 | 5 4 5 5 5 | 6 4 5 5 5 | 6 0 6 6 0 6 5 |
| B | Fe | 52 51 53 54 54 | 50 49 47 50 48 | 47 46 48 48 46 | 55 54 55 53 53 |
| | Mn | 58 55 57 57 56 | 56 56 54 54 53 | 56 55 57 58 57 | 60 62 62 60 61 |
| C | Fe | 102 100 101 99 100 | 100 97 99 99 97 | 97 94 95 93 93 | 100 99 ~~98 95 95~~ 104 103 101 |
| | Mn | 106 105 106 105 106 | 103 103 101 102 102 | 107 107 109 110 107 | 114 114 113 114 114 |

NaOAc gren

| | | SAN021 | SAN028 | SAN036 | SAN044 |
|---|---|---|---|---|---|
| A | Fe | 0 0 1 0 1 | 0 0 1 0 1 0 | 3 3 3 2 3 | 4 5 6 3 4 |
| | Mn | 17 19 19 18 18 | 21 21 22 21 21 | 10 11 11 10 11 | 10 8 9 10 8 |
| B | Fe | 40 39 40 39 38 | 37 36 37 39 ~~35~~ 40 | 32 28 30 27 28 | 38 42 38 39 41 |
| | Mn | 71 70 71 71 70 | 74 74 75 75 76 | 62 64 62 62 62 | 60 60 59 61 62 |
| C | Fe | 82 83 82 81 80 | 78 78 ~~81~~ 80 79 80 | 72 71 72 70 72 | 88 91 90 90 90 |
| | Mn | 122 123 124 125 123 | 127 128 126 127 127 | 112 114 114 113 112 | 110 107 111 111 110 |

$NH_2OH$ blue

| | | SAN021 | SAN028 | SAW036 | SAW044 |
|---|---|---|---|---|---|
| A | Fe | 15 17 16 14 14 | 33 34 30 28 29 | 30 29 29 30 30 | 18 18 19 21 19 |
| | Mn | 44 43 43 43 43 | 18 18 18 17 17 | ~~5 5 6 5 5~~<br>76 7 7 7 | ~~5~~ 5 5 5 5 |
| B | Fe | ~~56~~ 61 61 61 60 59 | 81 80 78 78 76 | 80 80 80 81 81<br>59 59 59 59 | 71 71 71 72 72 |
| | Mn | 91 90 91 91 90 | 69 69 68 68 69 | 58 ~~58 58 58 58~~ | 60 60 61 60 61 |
| C | Fe | 109 108 108 ~~109~~ 108 | 127 127 126 124 124 | 126 127 127 130 127<br>110 109 107 111 111 | 120 123 121 121 121 |
| | Mn | 143 144 144 146 144 | 119 119 118 120 117 | ~~105 106 108 106 108~~ | 112 113 112 111 110 |

# $MgCl_2$ red

| | | SAN-026 | SAN-035 | SAN043 | SAN051 |
|---|---|---|---|---|---|
| A | Cu | 6 6 6 6 6 | 5 6 5 6 5 | 6 6 5 5 5 | 5 5 5 5 4 |
| | Ag | 6 6 5 5 5 | 6 6 6 5 5 | 5 5 5 5 5 | 5 6 6 6 6 |
| | Co | 15 14 16 16 16 | 17 18 18 17 18 | 19 20 20 20 18 | 12 12 12 12 12 |
| | Pb | ~~6 8 6 5 8 9~~ 7 8 11 7 9 10 | ~~12 11 8 11 14~~ 11 12 13 11 11 | 10 14 13 10 10 | 12 11 12 12 10 |
| | Zn | 14 12 14 14 14 | 14 16 13 14 11 | 16 16 12 13 13 | 12 16 12 13 16 ~~9 9 7 7 7~~ |
| B | Cu | 64 64 64 64 63 | 63 64 63 62 63 | 63 64 63 62 62 | 63 64 63 63 63 |
| | Ag | 80 80 80 79 79 | 82 83 81 81 81 | 79 79 79 79 79 | 81 81 80 80 80 |
| | Co | 51 53 52 53 52 | 55 54 54 54 54 | 55 56 56 56 55 | 47 48 48 48 48 |
| | Pb | ~~28 29 29 27 27~~ 33 33 31 32 32 | 35 37 33 36 35 ~~33 34 30 30 32~~ | 35 35 34 35 35 | 37 36 35 34 36 |
| | Zn | 136 139 138 136 140 | 149 152 148 149 149 | 137 137 136 137 140 | 155 155 154 154 158 ~~149 148 146 143 146~~ |
| C | Cu | 121 121 120 119 119 | 120 121 119 119 120 | 120 118 120 120 120 | 119 119 120 119 118 |
| | Ag | 155 154 153 154 155 | 158 158 159 157 157 | 157 157 155 158 157 | 157 157 156 158 157 |
| | Co | 87 88 87 87 87 | 91 91 91 92 89 | 95 93 95 94 92 | 83 85 82 84 83 |
| | Pb | ~~51 53 52 51 51~~ 56 57 59 57 56 | ~~55 57 56 54 58~~ 59 60 58 59 55 | 61 62 62 62 62 | 62 60 59 60 59 |
| | Zn | 255 258 253 254 253 | 253 255 255 258 253 | 253 253 252 255 251 | 254 258 256 256 253 ~~248 245 246 243 2~~ |

NaOAc gm

| | | SAN-026 | SAN035 | SAN043 | SAN051 |
|---|---|---|---|---|---|
| A | Cu | 7 8 7 7 7 | 7 7 7 7 7 | 6 6 5 5 5 | 9 9 9 9 9 ~~10 10 10 10 10~~ |
| | Ag | ~~5~~ 5 5 5 5 | 4 4 4 4 4 | 4 4 4 3 3 | 5 5 5 5 4 |
| | Co | 18 18 19 17 17 | 21 21 21 22 20 | 18 18 18 18 18 | 12 13 11 12 13 |
| | Pb | 12 12 12 13 13 ~~10 10 10 12~~ 12 | 13 13 13 12 11 | 11 12 12 12 13 | 11 12 11 12 12 |
| | ZN | 56 56 56 55 54 | 99 97 101 98 97 | 39 42 42 42 39 | 30 31 31 31 32 |
| B | Cu | 69 69 69 69 69 | 67 68 67 66 ~~69~~ | 65 66 66 67 65 | 74 74 73 73 74 |
| | Ag | 60 60 60 60 60 | 59 59 58 57 58 | 62 61 62 63 64 | 65 66 65 65 65 |
| | Co | 55 56 54 54 55 | 58 58 57 58 58 | 55 55 56 55 56 | 50 50 50 49 50 |
| | Pb | 36 35 35 35 35 | 38 38 35 ~~40~~ ~~37~~ | 38 38 37 39 37 | 36 37 37 36 36 |
| | ZN | 188 185 184 185 184 | 233 233 233 232 234 | 174 173 172 173 173 | 172 171 173 170 170 |
| C | Cu | 127 127 127 127 127 | 127 127 126 126 127 | 127 126 126 126 126 | 130 131 132 130 130 |
| | Ag | 118 117 118 118 120 | 107 108 108 108 108 | 114 118 119 117 117 | 119 120 119 119 118 |
| | Co | 92 92 92 93 91 | 95 95 95 95 95 | 92 92 92 92 91 | 87 87 86 86 87 |
| | Pb | 62 63 60 61 61 | 63 64 65 65 65 | 63 62 62 65 64 | 64 63 64 63 63 |
| | ZN | 308 308 307 305 304 | 352 347 343 346 344 | 294 297 297 293 294 | 289 288 287 293 288 |

$NH_2OH$ blue

| | | SAN 026 | SAN035 | SAN043 | SAN051 |
|---|---|---|---|---|---|
| A | Cu | 5 5 4 4 4 | 3 3 3 4 3 | 3 2 2 2 2 | 11 12 12 12 12 |
| | Ag | 2 2 2 2 2 | 1 0 0 0 0 | 0 0 0 0 0 | 1 1 1 1 1 |
| | Co | 8 8 8 8 9 | 9 10 9 10 10 | 7 8 8 8 7 | 10 10 10 10 9 |
| | Pb | 16 13 15 14 14 | 13 11 13 13 10 | 14 16 15 14 16 | 14 13 15 15 15 |
| | ZN | 94 94 94 95 92 | 106 105 102 104 102 | 33 35 33 33 35 | 84 80 86 81 80 |
| B | Cu | 78 78 78 78 78 | 79 78 77 77 77 | 74 75 73 75 74 | 86 86 86 86 86 |
| | Ag | 81 80 80 80 80 | 80 79 79 80 79 | 80 79 79 79 80 | 83 82 82 82 82 |
| | Co | 54 54 54 53 52 | 56 57 57 56 55 | 54 53 54 54 54 | 55 56 56 55 54 |
| | Pb | 43 45 44 47 43 | 43 44 42 44 44 | 47 48 46 45 45 | 44 44 44 42 46 |
| | ZN | 244 248 244 248 246 | 260 257 255 258 260 | 193 193 190 191 191 | 265 266 262 264 264 |
| C | Cu | 146 146 148 146 145 | 148 145 146 146 145 | 144 143 144 145 143 | 153 152 153 153 153 |
| | Ag | 156 153 155 157 154 | 150 148 150 149 150 | 152 151 150 152 152 | 157 158 157 157 157 |
| | Co | 99 99 99 99 99 | 101 101 102 100 102 | 99 99 99 97 98 | 103 103 101 102 102 |
| | Pb | 76 76 76 77 77 | 76 76 75 74 74 | 76 77 78 80 76 | 77 76 77 79 76 |
| | ZN | 380 381 379 378 380 | 399 396 391 397 395 | 330 331 328 330 331 | 380 378 376 379 376 |

MgCl2 ND

| | | SAN026 | SAN035 | SAN043 | SAN051 |
|---|---|---|---|---|---|
| A | Fe | 10300 | 04314 | 32412 | 10213 |
| | Mn | 22201 | 24443 | 44555 | 55466 |
| B | Fe | 43 45 44 46 44 | 45 46 47 49 48 | 49 48 50 47 48 | 45 48 44 47 44 |
| | Mn | 47 47 48 46 46 | 51 49 47 50 49 | 49 51 50 49 49 | 49 51 48 48 49 |
| C | Fe | 93 92 92 91 89 | 93 88 92 94 91 | 95 93 92 94 95 | 92 94 92 89 93 |
| | Mn | 93 93 93 92 94 | 94 94 95 94 93 | 94 93 96 94 94 | 93 92 94 92 93 |

.0026
.047
.0916

NaOAc

| | | SAN026 | SAN035 | SAN043 | SAN051 |
|---|---|---|---|---|---|
| A | Fe | 6 3 3 4 3 | 2 3 21 22 22 23 | 20 20 20 20 18 | 2 4 3 3 3 |
| | MW | 15 12 13 13 14 | 11 11 12 12 10 | 7 7 7 7 7 | 9 9 9 9 9 |
| B | Fe | 45 46 47 46 48 | 67 66 68 68 66 | 61 62 64 61 62 | 40 41 42 40 38 |
| | MW | 59 59 59 59 59 | 57 59 57 56 57 | 52 51 53 55 54 | 56 56 56 55 56 |
| C | Fe | 88 89 88 89 87 | 111 113 110 112 111 | 111 108 108 109 106 | 76 77 77 77 76 |
| | MW | 105 102 103 104 104 | 102 101 101 102 103 | 100 99 100 97 97 | 99 100 100 100 99 |

$NH_2OH$ [illegible]

| | | SAN026 | SAN035 | SAN043 | SAN051 |
|---|---|---|---|---|---|
| A | Fe | 28 29 29 29 29 | 36 39 38 38 39 | 20 20 20 20 18 | 24 27 25 22 21 |
| | Mn | 7 7 7 7 7 | 5 6 5 4 5 | 5 4 2 3 4 | 12 12 12 11 11 |
| B | Fe | 70 75 73 73 76 | 82 80 80 81 81 | 64 65 66 64 68 | 64 66 68 68 69 |
| | Mn | 54 56 55 56 55 | 52 52 52 52 52 | 51 52 52 52 52 | 58 61 61 58 60 |
| C | Fe | 118 119 119 115 117 | 125 122 125 129 126 | 109 108 108 107 109 | 110 113 111 109 112 |
| | Mn | 99 98 99 99 101 | 99 98 95 98 96 | 96 98 95 96 96 | 105 105 105 106 106 |

# $MgCl_2$ red

| | | SAN042 | SAN 050 | SAN-052 | A | B |
|---|---|---|---|---|---|---|
| A | Cu | 5 5 4 5 5 | 4 5 4 5 5 | 5 5 5 5 4 | 10 10 10 10 10 | 7 8 7 8 7 |
| | Ag | 4 4 4 4 4 | 4 4 4 4 4 | 4 4 4 4 4 | 11 11 11 11 11 | 7 7 7 7 7 |
| | Co | 15 15 15 15 14 | 16 15 15 15 14 | 16 16 16 16 15 | 10 10 10 10 10 | 7 7 7 8 7 |
| | Pb | 9 8 7 8 6 | 9 8 8 8 8 | 8 9 7 7 5 | 11 11 11 10 11 | 8 8 8 8 7 |
| | Zn | 10 11 9 8 9 | 15 14 14 12 14 | 11 14 14 11 12 | 40 41 44 39 40 | 24 23 25 26 23 |
| B | Cu | 64 65 63 63 63 | 62 62 62 61 62 | 64 64 64 63 63 | 69 69 68 69 69 | 66 65 66 65 65 |
| | Ag | 81 81 81 81 81 | 81 81 81 82 82 | 81 81 81 81 81 | 87 87 88 87 88 | 84 84 84 81 83 |
| | Co | 50 52 50 51 51 | 52 53 52 51 52 | 53 54 53 53 52 | 48 46 46 47 46 | 45 46 45 46 45 |
| | Pb | 30 31 29 30 29 | 32 31 34 33 31 | 34 33 32 34 32 | 36 ~~37~~ 36 36 37 37 | 34 34 32 33 32 |
| | Zn | 151 149 149 149 150 | 144 146 143 147 146 | 146 145 145 148 145 | 177 176 178 176 176 | 153 154 154 154 153 |
| C | Cu | 121 122 119 120 120 | 119 118 119 119 119 | 121 121 121 120 122 | 127 126 126 126 126 | 124 124 124 123 124 |
| | Ag | 158 158 157 157 158 | 159 159 158 159 158 | 158 158 157 157 156 | 166 165 166 166 164 | 160 162 162 162 161 |
| | Co | 8 8 8 8 8 8 8 8 8 | 89 88 88 88 88 | 90 90 91 89 88 | 83 84 83 83 83 | 84 83 84 82 83 |
| | Pb | 56 56 55 55 54 | 58 56 57 57 56 | 58 59 59 57 59 | 63 64 65 64 65 | 61 59 57 60 59 |
| | Zn | 268 271 269 267 267 | 279 282 279 279 281 | 273 275 272 272 269 | 296 292 294 295 294 | 272 273 278 275 275 |

# NaOAc gum

| | | SAN042 | SAN050 | SAN052 | A | B |
|---|---|---|---|---|---|---|
| | Cu | 9 9 10 10 10 | 9 10 10 10 10 | 9 9 8 9 8 | 8 8 8 9 9 | 7 7 8 8 7 7 |
| A | Ag | 4 4 4 4 4 | 4 4 4 4 4 | 4 4 4 4 4 | 12 12 12 12 12 | 8 8 8 8 8 |
| | Co | 16 16 15 15 16 | 12 12 12 12 13 | 16 16 16 16 16 | 10 11 9 10 10 | 9 9 9 9 9 |
| | Pb | 9 10 9 11 9 | 10 9 8 8 10 | 10 10 10 8 9 | 12 11 10 10 12 | 9 7 9 8 8 |
| | ZN | 32 31 31 31 32 | 32 33 34 31 30 | 33 31 32 33 32 | 42 43 43 43 43 | 30 30 30 30 30 |
| B | Cu | 73 73 73 74 72 | 72 72 71 71 72 | 69 70 70 71 69 | 71 71 70 70 70 | 69 69 68 69 70 |
| | Ag | 70 70 70 70 71 | 70 70 71 72 71 | 71 70 71 71 71 | 92 92 93 92 93 | 87 88 87 87 87 |
| | Co | 55 54 55 55 54 | 51 51 51 52 52 | 53 54 55 53 55 | 49 49 50 49 49 | 48 48 48 48 48 |
| | Pb | 38 36 37 38 37 | 35 38 36 38 36 | 36 34 36 35 35 | 36 35 37 36 37 | 34 34 35 35 34 |
| | ZN | 170 168 173 172 170 | 172 171 173 172 170 | 172 171 173 170 172 | 182 185 183 182 183 | 169 171 170 169 170 |
| C | Cu | 134 136 135 135 135 | 134 134 132 133 133 | 134 137 132 134 134 | 132 131 132 133 133 | 130 130 130 130 131 |
| | Ag | 133 134 135 132 133 | 132 132 134 133 134 | 136 137 135 136 135 | 163 163 163 164 162 | 161 161 160 159 160 |
| | Co | 93 93 93 93 93 | 91 91 91 90 91 | 93 93 93 92 93 | 87 88 87 88 88 | 87 87 87 87 86 |
| | Pb | 63 64 64 62 64 | 64 63 64 63 65 | 65 63 63 64 64 | 63 64 65 63 63 | 59 62 62 62 63 |
| | ZN | 301 301 303 303 301 | 303 301 302 299 298 | 300 304 303 303 304 | 312 315 309 312 309 | 298 300 301 299 300 |

# $NH_2OH$ values

| | | SAN042 | SAN050 | SAN052 | A | B |
|---|---|---|---|---|---|---|
| A | Cu | 8 8 8 8 9 | 5 4 4 4 4 | 7 7 7 7 6 | 9 8 8 9 8 | 5 5 5 4 4 |
| | Ag | 0 0 0 0 0 | 0 0 0 0 0 | 0 0 0 0 0 | 8 8 8 8 8 | 5 4 4 5 5 |
| | Co | 10 11 10 11 10 | 4 3 4 4 4 | 6 6 7 7 5 | 8 8 8 8 8 | 4 5 5 5 5 |
| | Pb | 8 8 9 8 9 | 9 8 11 11 9 | 9 7 9 9 8 | 11 11 12 10 11 | 8 9 10 8 8 |
| | Zn | 68 71 73 72 72 | 28 27 29 28 28 | 36 38 36 38 38 | 45 44 46 44 45 | 32 29 31 29 30 |
| B | Cu | 81 82 82 82 82 | 79 79 78 78 78 | 80 81 82 81 83 | 81 82 82 82 82 | 77 75 76 76 76 |
| | Ag | 82 82 82 83 82 | 82 81 81 82 81 | 80 82 81 80 80 | 90 88 88 88 88 | 84 85 84 84 84 |
| | Co | 57 56 56 56 57 | 50 50 49 49 50 | 51 50 50 51 52 | ~~50 51~~ 53 52 52 53 54 | 48 50 50 50 50 |
| | Pb | 39 39 40 38 40 | 42 43 43 43 43 | 42 45 40 42 42 | 43 43 43 44 42 | 39 41 39 41 38 |
| | Zn | 227 229 229 230 229 | 192 194 193 192 192 | 198 197 197 199 198 | 207 208 207 207 208 | 189 190 191 192 191 |
| C | Cu | 154 155 155 154 153 | 151 152 150 151 152 | 153 155 153 151 152 | 156 155 155 155 155 | 149 148 148 147 147 |
| | Ag | 163 163 162 162 161 | 163 161 162 161 162 | 159 161 160 159 160 | 168 168 168 168 169 | 161 162 162 161 161 |
| | Co | 101 102 102 101 102 | 95 96 95 95 95 | 95 96 97 97 96 | ~~94 94 94 94 94~~ 97 97 98 97 98 | 94 94 93 93 93 |
| | Pb | 70 71 72 74 73 | 76 78 77 76 76 | 76 74 75 75 75 | 75 77 76 77 78 | 72 71 74 71 71 |
| | Zn | 379 374 374 377 376 | 338 339 343 343 340 | 350 348 344 347 348 | 360 362 363 357 356 | 337 340 336 335 337 |

$MgCl_2$ red

| | | SAN042 | SAN050 | SAN052 | A | B |
|---|---|---|---|---|---|---|
| A | Fe | 2 4 2 3 2 | 2 3 1 1 1 | 1 1 1 1 1 | 6 6 7 6 8 | 3 3 3 3 3 |
| | MN | 4 5 4 4 4 | 6 6 5 5 5 | 3 5 3 2 3 | 12 11 12 13 11 | 5 5 6 7 5 |
| B | Fe | 5 8 5 7 5 7 5 5 5 4 | 5 6 5 6 5 6 5 6 5 6 | 5 3 5 4 5 5 5 4 5 5 | 6 3 6 2 6 1 6 2 6 2 | 5 9 5 7 5 8 5 7 5 9 |
| | MN | 6 2 6 3 6 1 6 0 6 0 | 5 9 5 9 5 9 5 9 6 1 | 5 8 5 8 5 7 5 7 5 6 | 6 6 6 6 6 4 6 4 6 5 | 6 0 6 2 6 0 6 1 6 1 |
| C | Fe | 111 110 111 111 111 | 108 108 111 111 110 | 107 110 108 110 106 | 117 115 116 116 116 | 113 112 112 113 112 |
| | MN | 115 114 114 114 116 | 110 108 109 110 109 | 110 110 109 109 111 | 115 117 116 117 117 | 112 112 111 114 111 |

NaOAc gm

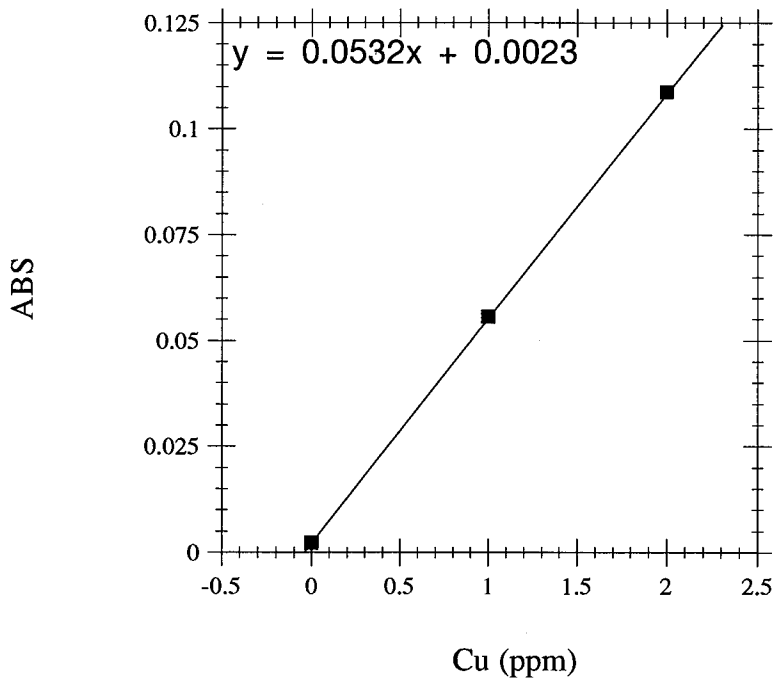
| | | SAN042 | SAN050 | SAN052 | A | B |
|---|---|---|---|---|---|---|
| A | Fe | 8 7 6 8 6 | 17 16 16 17 18 | 14 13 15 16 15 | 5 5 4 6 3 | 2 2 4 4 3 |
| | Mn | 11 11 11 11 12 | 9 7 8 8 8 | 9 10 10 10 9 | 11 11 11 11 12 | 5 7 6 6 6 |
| B | Fe | 58 60 61 60 58 | 70 69 70 70 70 | 67 65 68 67 67 | 53 53 56 54 56 | 55 58 57 60 56 |
| | Mn | 65 66 67 67 65 | 66 64 65 64 65 | 64 65 66 66 66 | 66 66 65 65 65 | 64 64 63 63 65 |
| C | Fe | 106 108 108 107 108 | 125 124 123 124 122 | 119 120 119 120 118 | 103 104 101 103 103 | 108 110 107 106 107 |
| | Mn | 118 116 119 117 118 | 119 118 120 119 119 | 117 119 118 118 119 | 120 119 121 121 120 | 118 118 118 121 118 |

$NH_2OH$ brine

| | | SAN042 | SAN050 | SAN052 | A | B |
|---|---|---|---|---|---|---|
| A | Fe | 4 9 4 9 4 9 4 7 4 8 | 2 7 2 6 2 6 2 4 2 7 | 4 2 4 4 4 3 4 3 4 2 | 3 2 3 3 3 | 1 3 2 1 2 |
| | Mn | ~~1 1 1 1 1 1 0 1 1~~ 7 7 7 7 8 | 4 3 3 3 3 | 3 3 2 3 3 | 4 4 5 4 4 | 2 2 2 2 2 |
| B | Fe | 100 101 101 101 100 | 81 81 83 83 82 | 99 97 98 96 96 | 56 55 56 55 54 | 53 51 52 53 53 |
| | Mn | ~~65 64 70 69 72~~ 65 63 63 | 60 60 59 60 60 | 59 61 61 60 61 | 61 61 61 60 61 | 58 57 54 56 56 |
| C | Fe | 156 153 154 155 154 | 134 133 135 137 137 | 151 149 149 150 149 | 107 109 105 106 107 | 104 103 106 102 105 |
| | Mn | ~~128 127 127 128 127~~ 120 119 119 121 119 | 113 113 113 113 113 | 117 114 117 116 114 | 115 114 114 115 116 | 111 112 113 110 111 |

Cu data

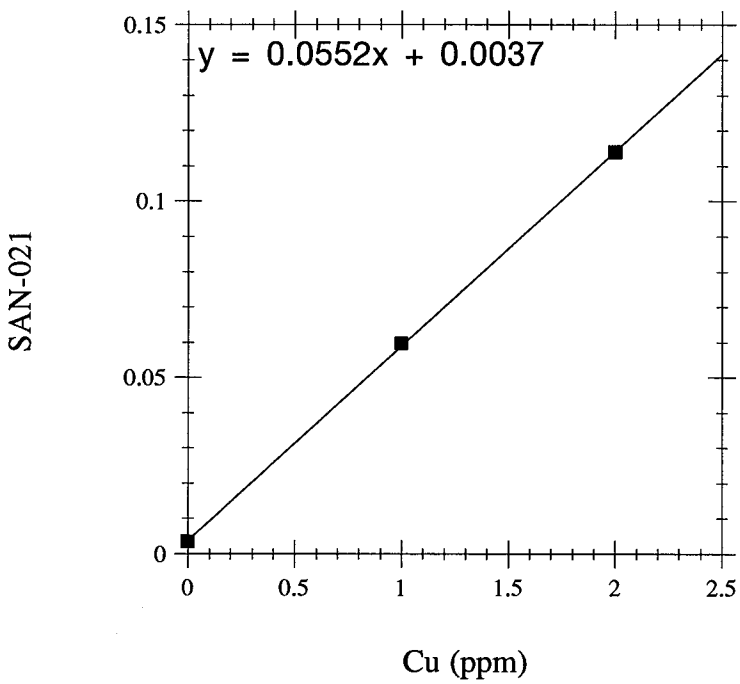
SAN-022 MgCl2




.0432 x 2 = .0864

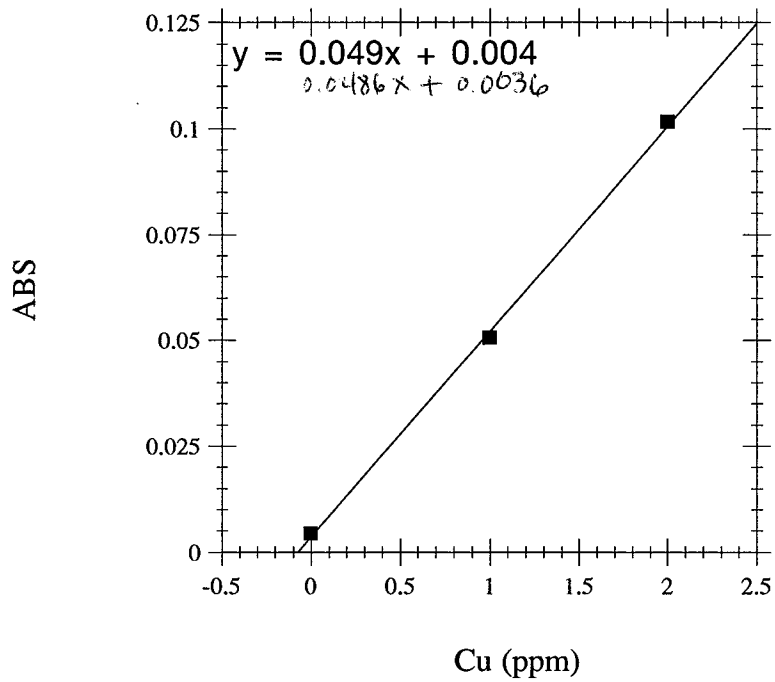
.0864 x $\frac{8\ ml}{1.6218\ g}$ = .676 ppm

SAN-021 MgCl2




.0670 x 2 = .134 x 8/1.016 = 1.055 ppm

SAN-023 MgCl2




~~.082~~
~~x2 = .164~~

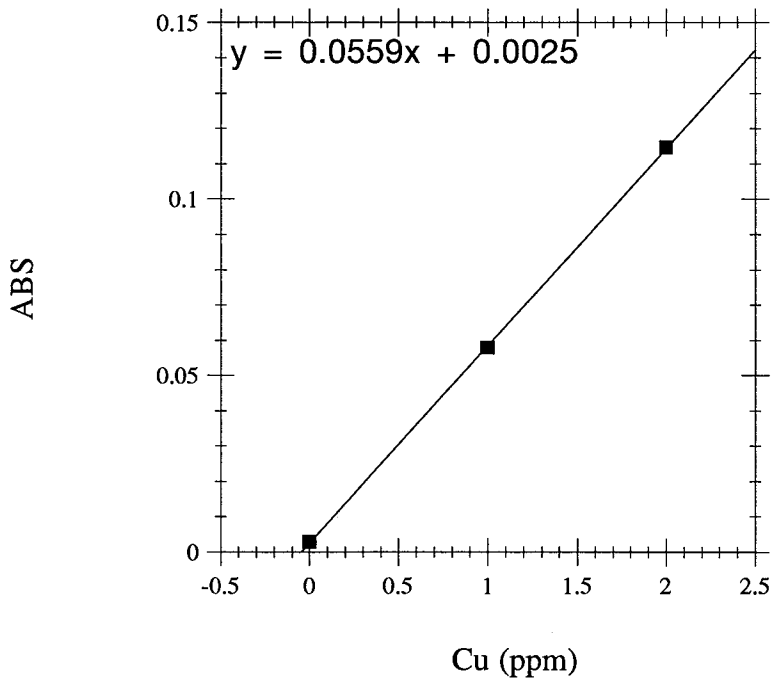
~~.164 x 8/1.022 =~~

~~1.284 ppm~~

.0741
x2 = .1482

.1482 x 8/1.022 = 1.16 ppm

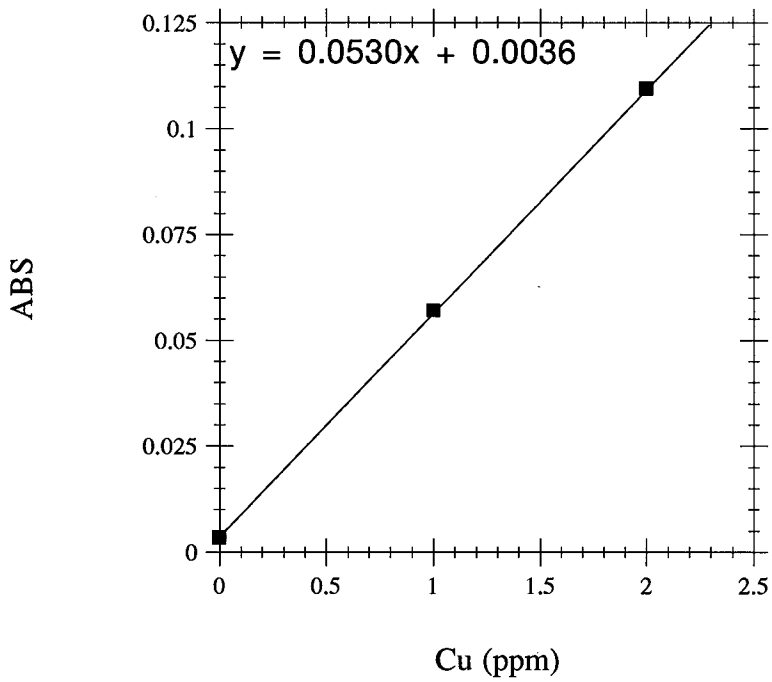
SAN-024 MgCl2




.0447 x 2 = .0894

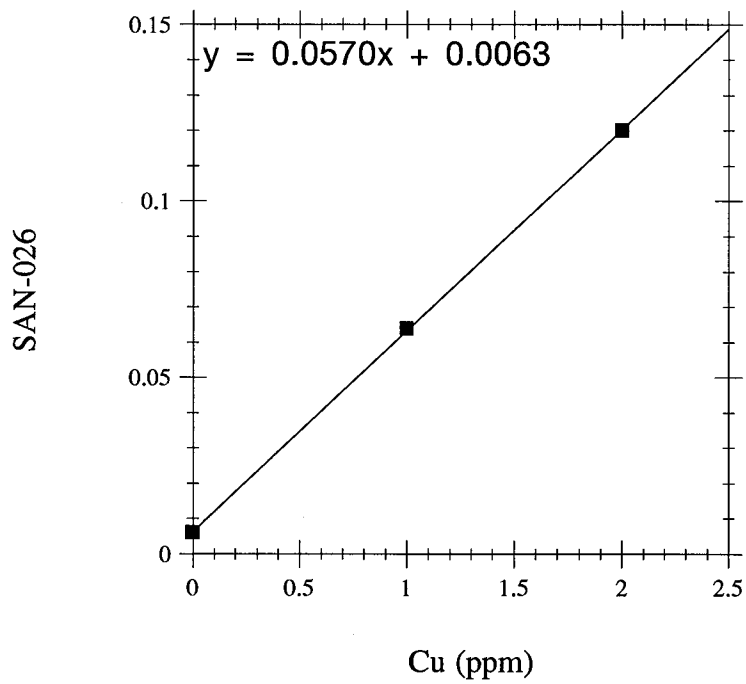
.0894 x 8 / 1.0183 = .702 ppm

SAN-025 MgCl2



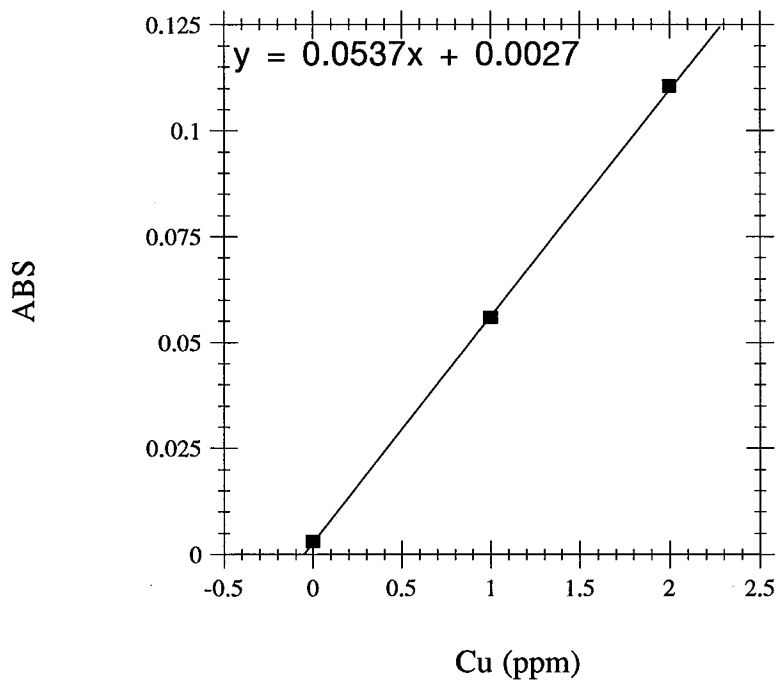

$.0679 \times 2 = .1358 \times \frac{8}{1.025} = 1.06$ ppm

SAN-026 MgCl2



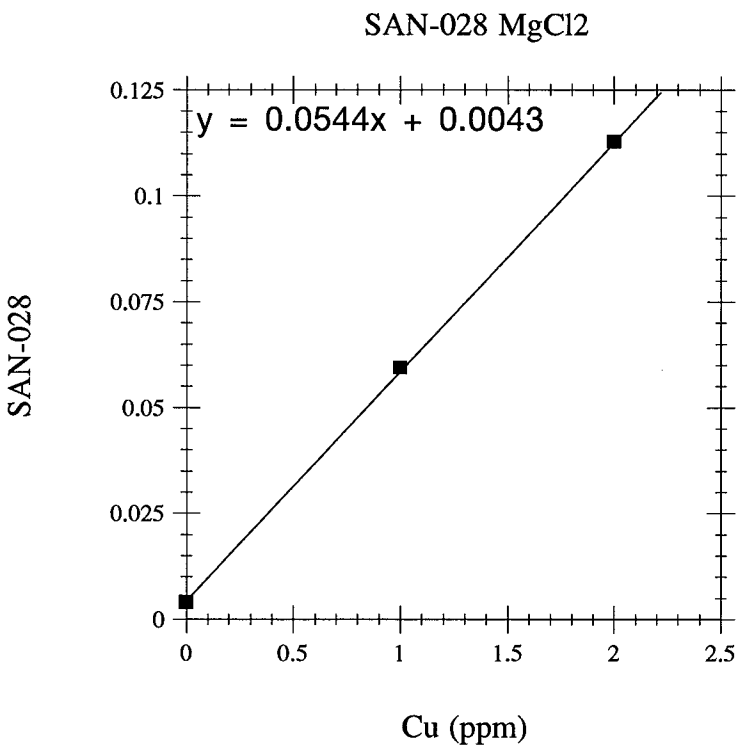

$.1105 \times 2 = .221 \times \frac{8}{1.021} = 1.732$ ppm

SAN-027 MgCl2



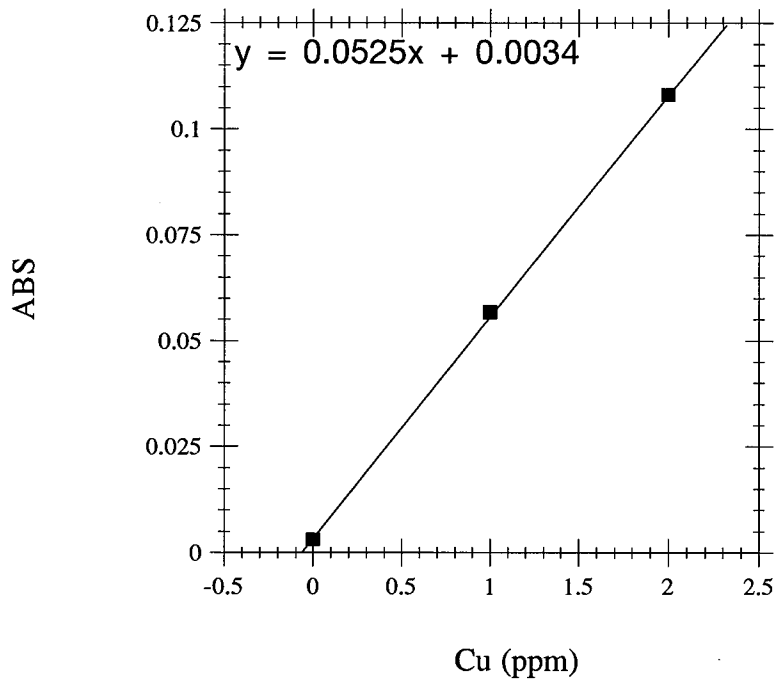

.6503 x 2 = .1006

.1006 x 8/1.013 = .794 ppm




.079 x 2 = .158 x 8 / 1.023 = 1.236 ppm

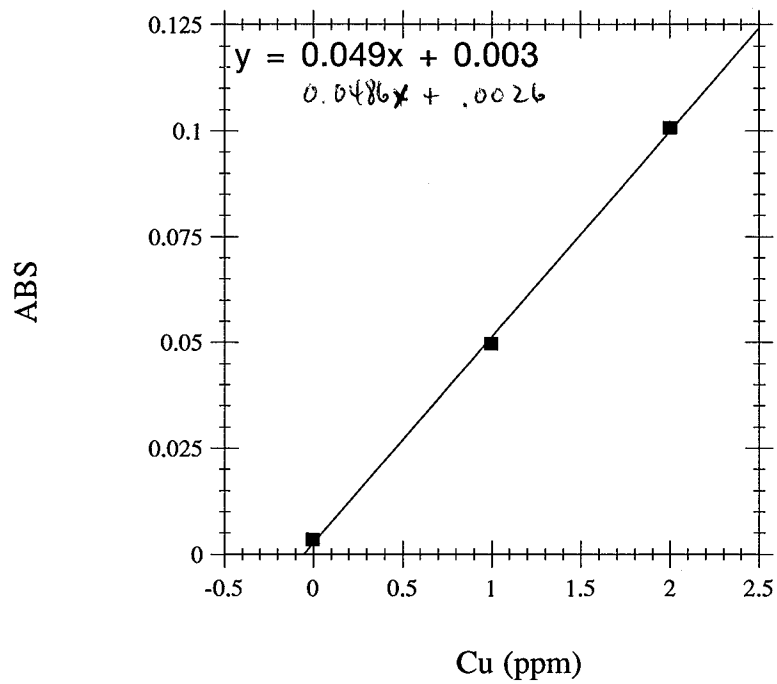
SAN-029 MgCl2




~~.04~~ .0648 x 2 = .1296

.1296 x ~~2~~ 1.0205 = 1.016 ppm

SAN-030 MgCl2




~~.061~~

~~x2 = .122~~

~~.122 x 8g soln / 1.022 g solid =~~

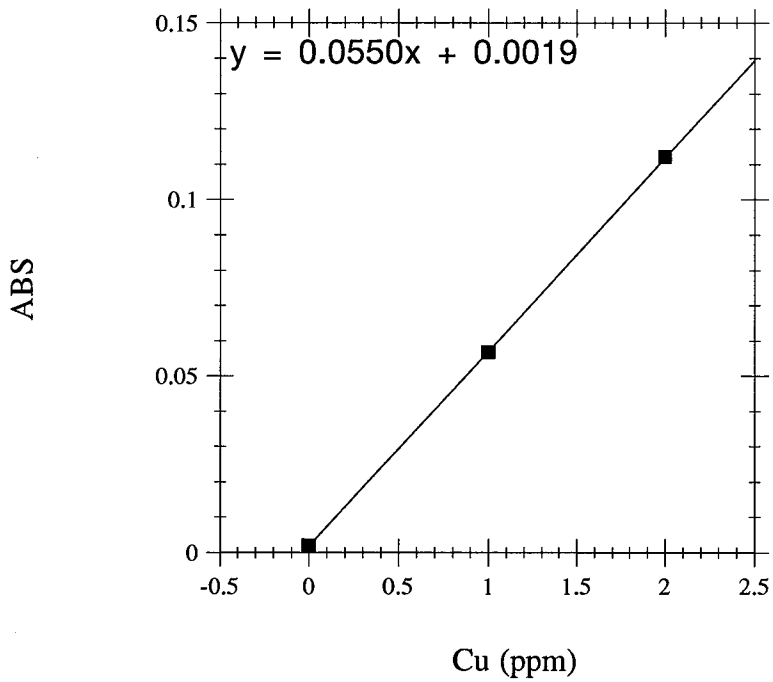
~~.955 ppm~~

.0535

x2 = .107

.107 x 8/1.022 = .837 ppm

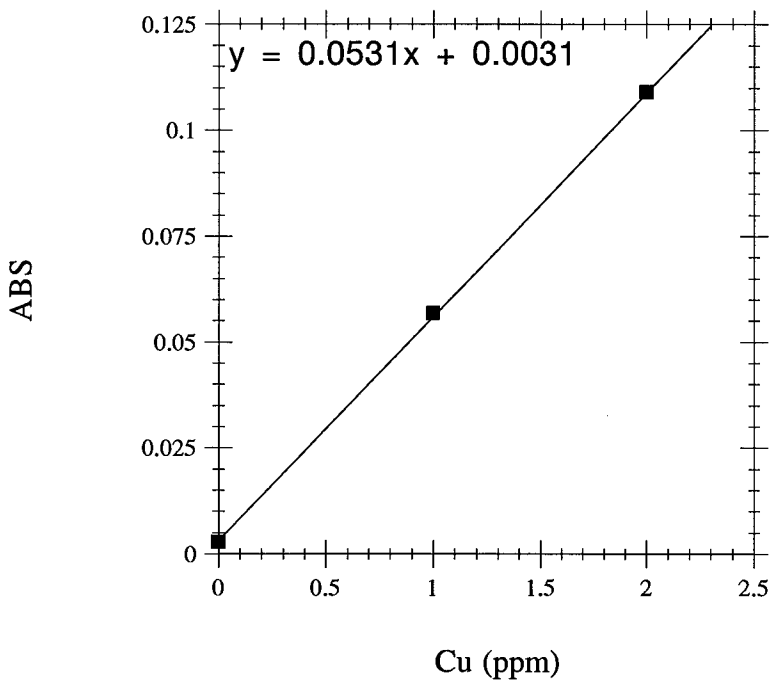
SAN-031 MgCl2




.0345 x 2 = .069

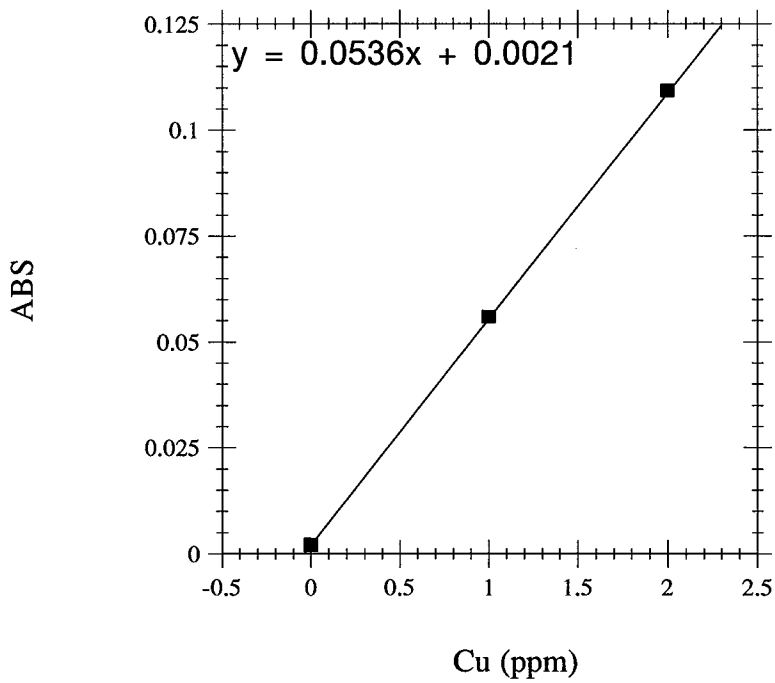
.069 x 8/1.0258 = .538 ppm

SAN-032 MgCl2



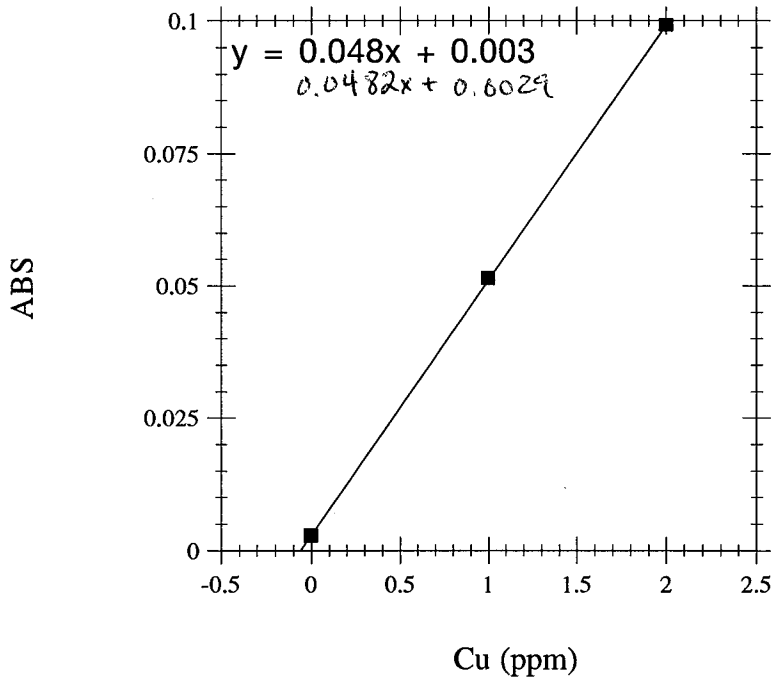

$.0584 \times 2 = .1168 \times \frac{8}{1.017} = .919\ ppm$

SAN-033 MgCl2




$.0392 \times 2 = .0784 \times \frac{8}{1.012} = .6197$ ppm

SAN-034 MgCl2

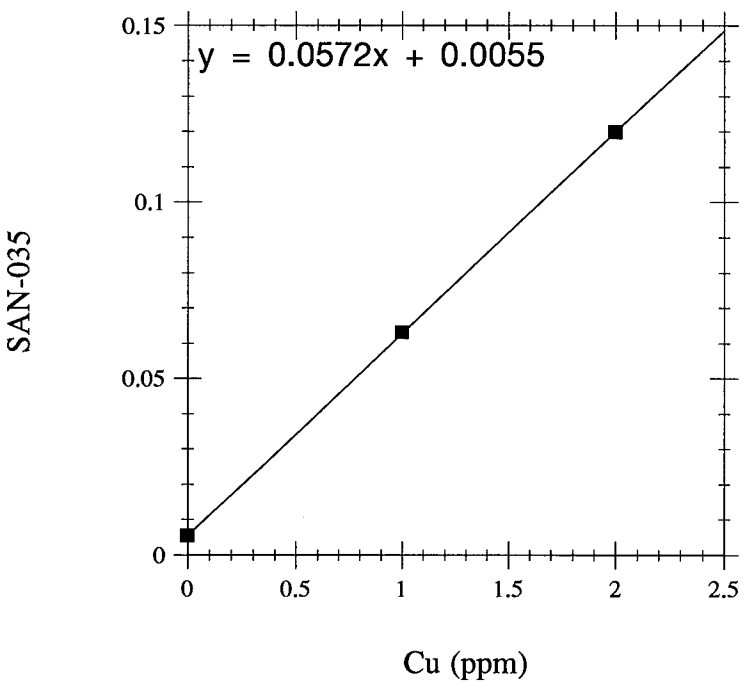



.060

x2 = .120

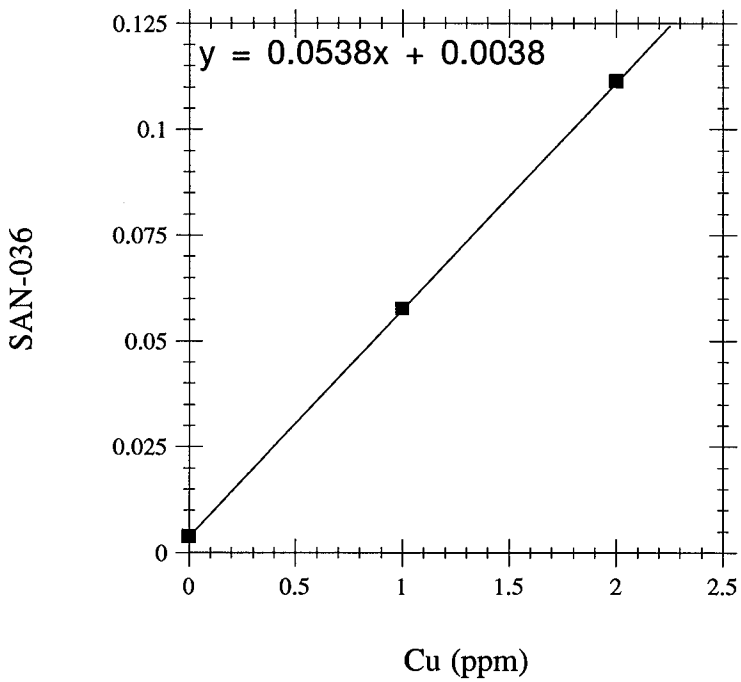
$.120 \times \frac{8}{1.009} = .951$ ppm

SAN-035 MgCl2



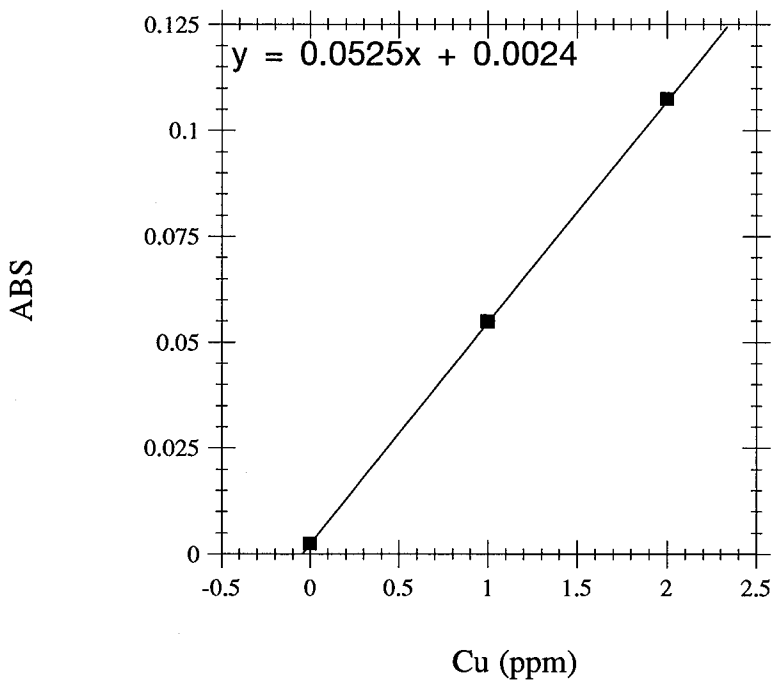

$.0961 \times 2 = .1922 \times \frac{8}{1.02} = 1.507 ppm$

SAN-036 MgCl2




$.0706 \times 2 = .1412 \times \frac{8}{1.014} = 1.114$ ppm

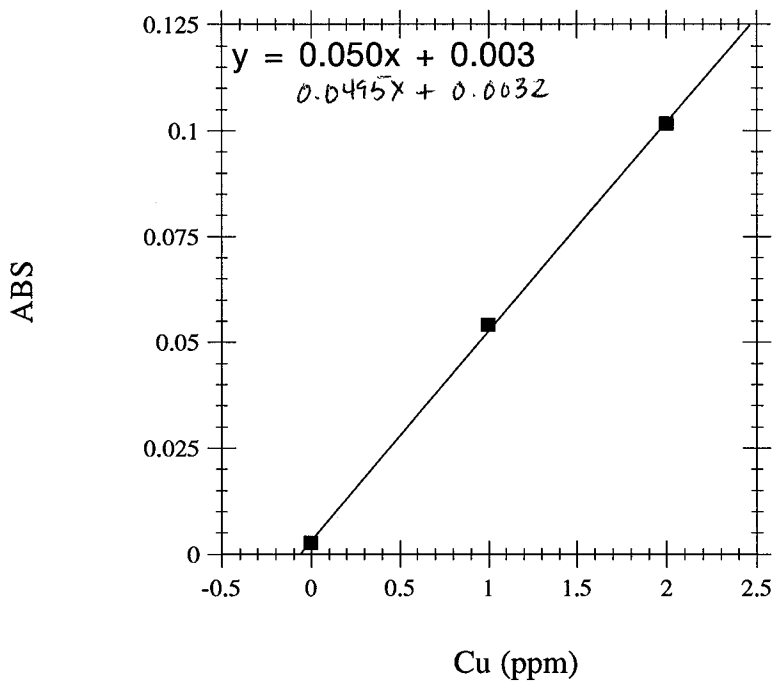
SAN-037 MgCl2




.0457 x 2 = .0914

.0914 x 8/1.0212 = .716 ppm

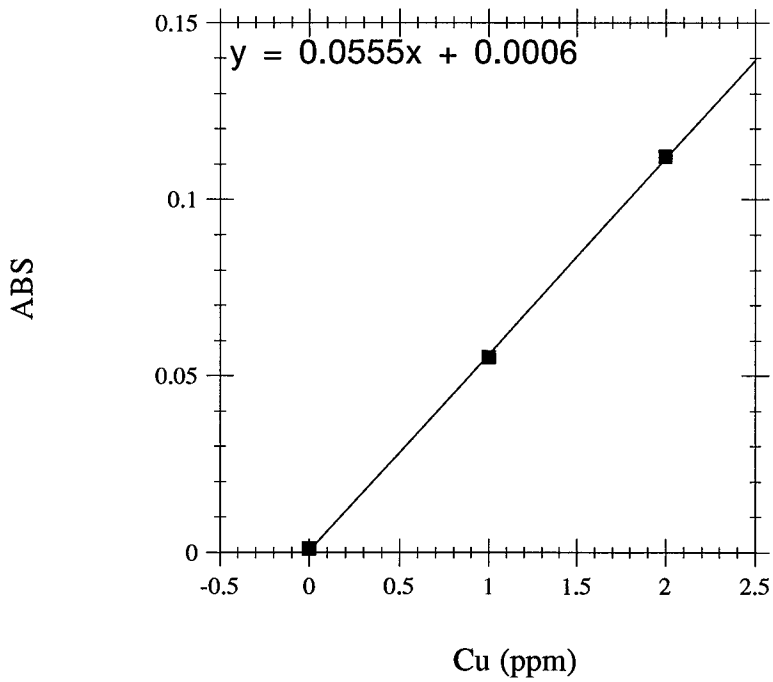
SAN-038 MgCl2




.0646
x2 = .1292

$.1292 \times \frac{8}{1.024} = 1.009$ ppm

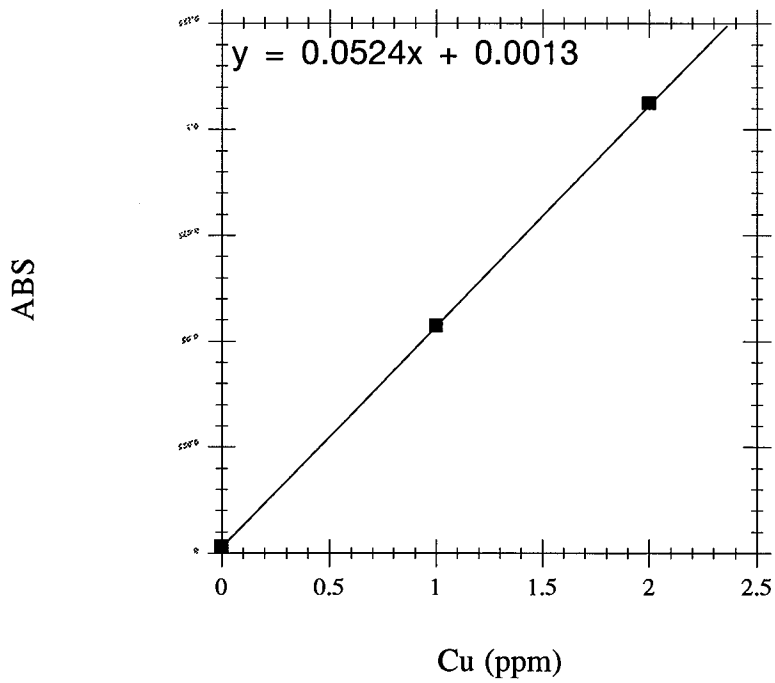
SAN-039 MgCl2




.0108 x 2 = .0216

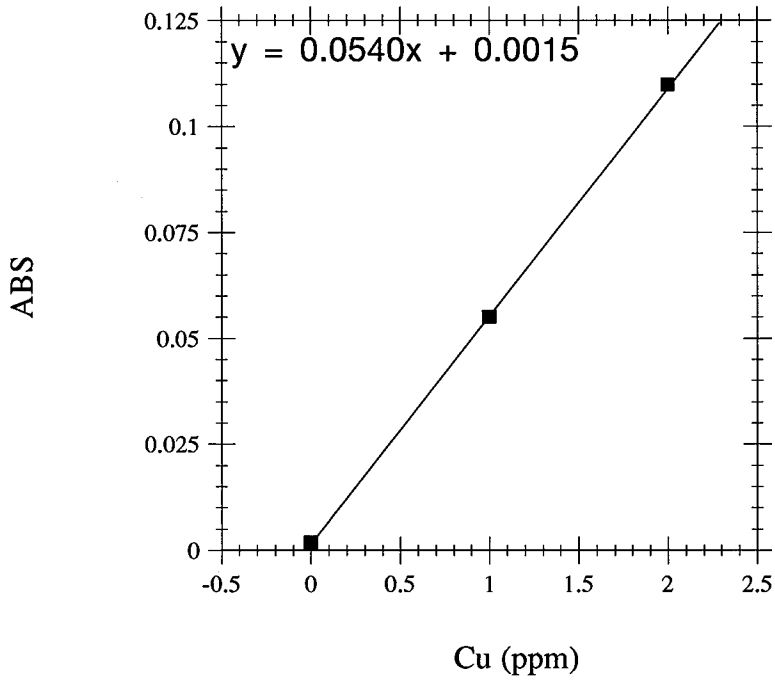
.0216 x 8/1.018 = .169 ppm

SAN-040 MgCl2



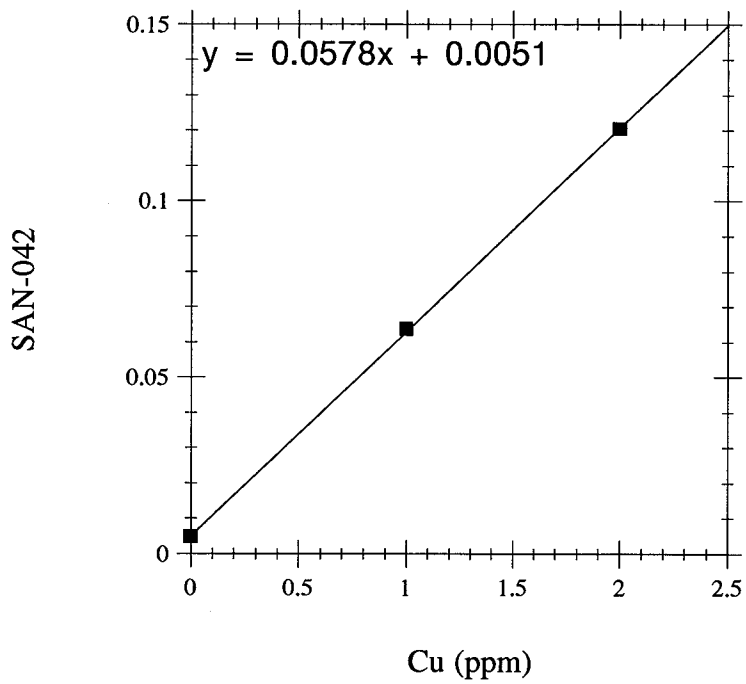

.6248 x 2 = .0496 x 8 / 1.017 = .390 ppm

SAN-041 MgCl2



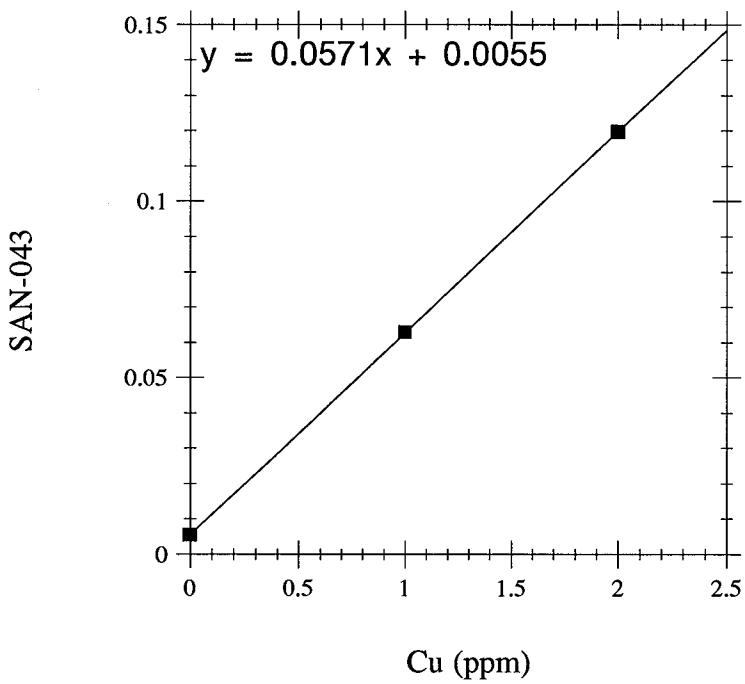

$.0278 \times 2 = .0556 \times \frac{8}{1.015} = .438$ ppm

SAN-042 MgCl2



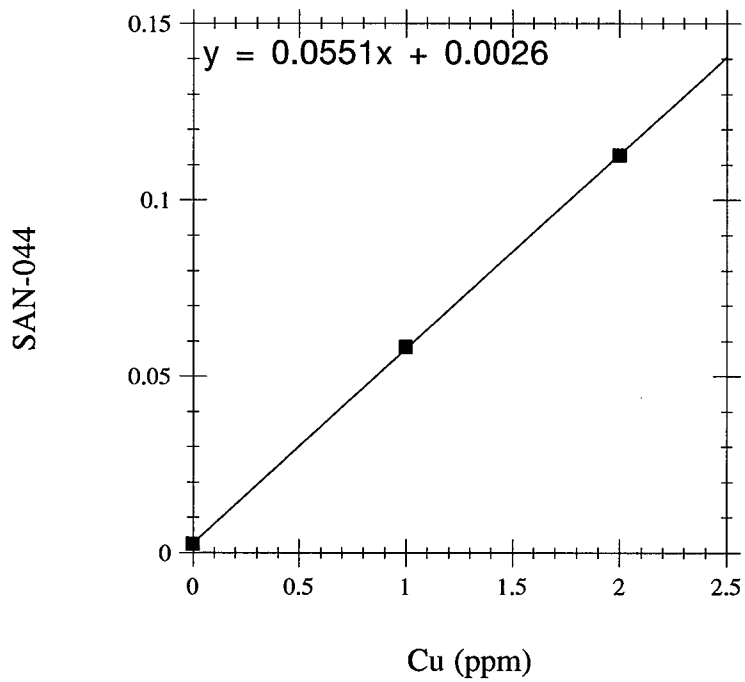

$.0882 \times 2 = .1764 \times \frac{8}{1.012} = 1.394$ ppm

SAN-043 MgCl2



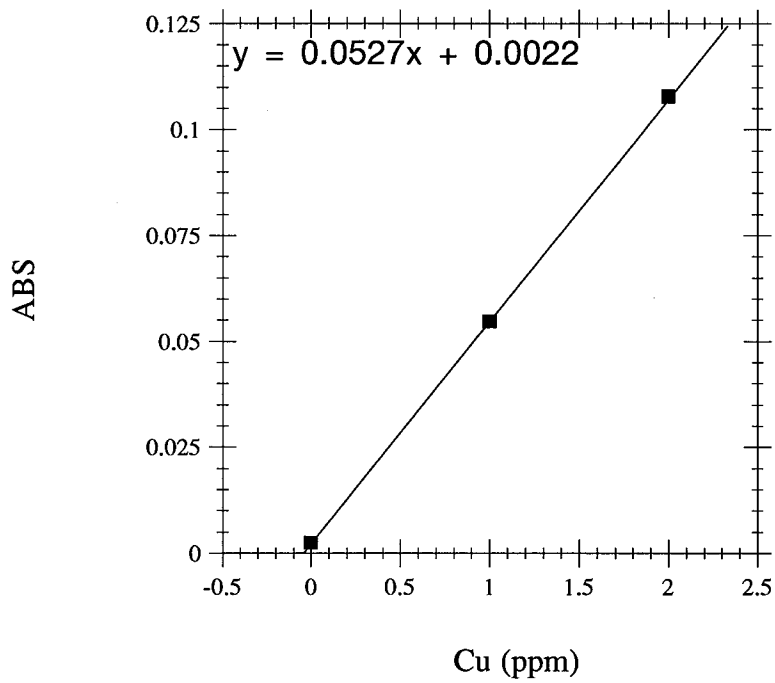

$.0963 \times 2 = .1926 \times \frac{8}{1.022} = 1.5098$ ppm

SAN-044 MgCl2




$.0472 \times 2 = .0944 \times \frac{8}{1.014} = .745\ ppm$

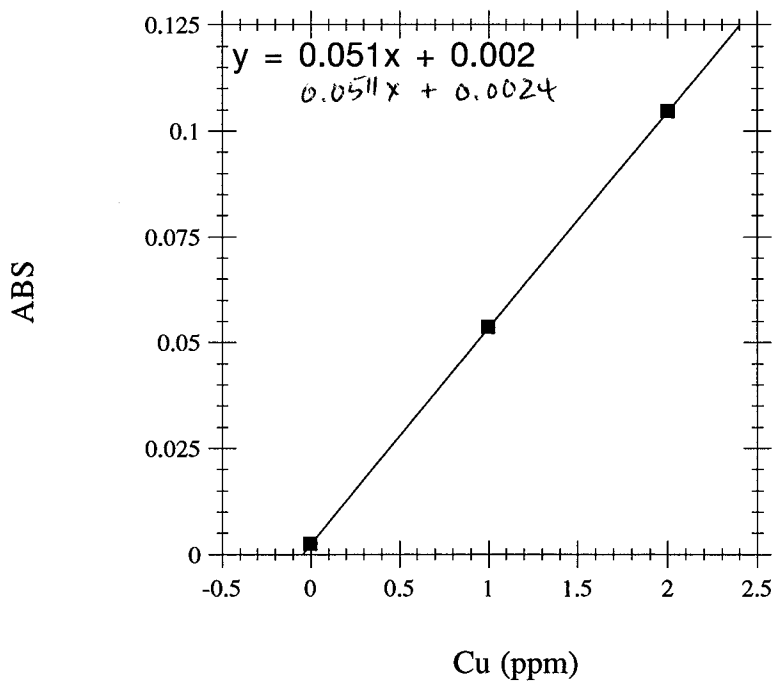
SAN-045 MgCl2




.0417 x 2 = .0834

$\frac{.0834 \times 8}{1.0168} = .656$ ppm

SAN-046 MgCl2

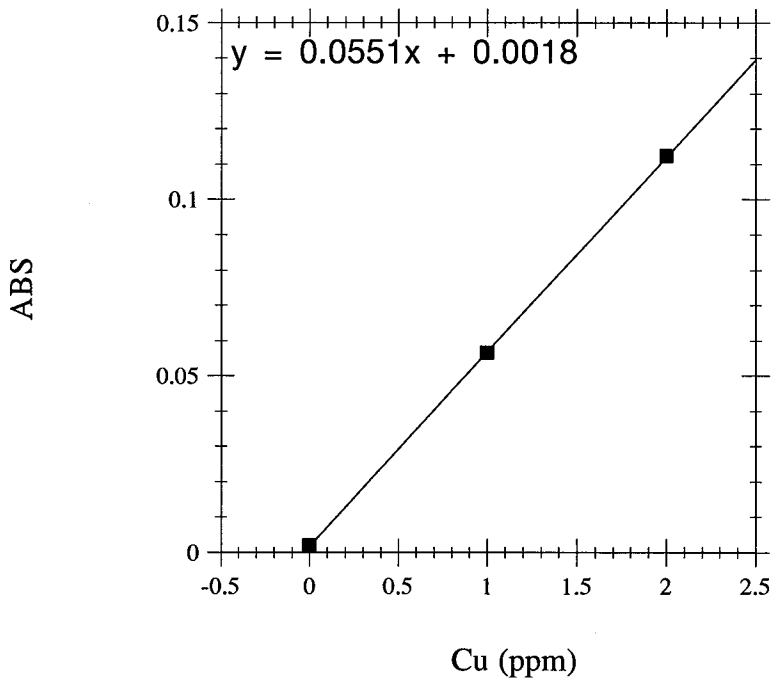



.0469

x 2 = .0938

$.0938 \times \frac{8}{1.022} = .734$ ppm

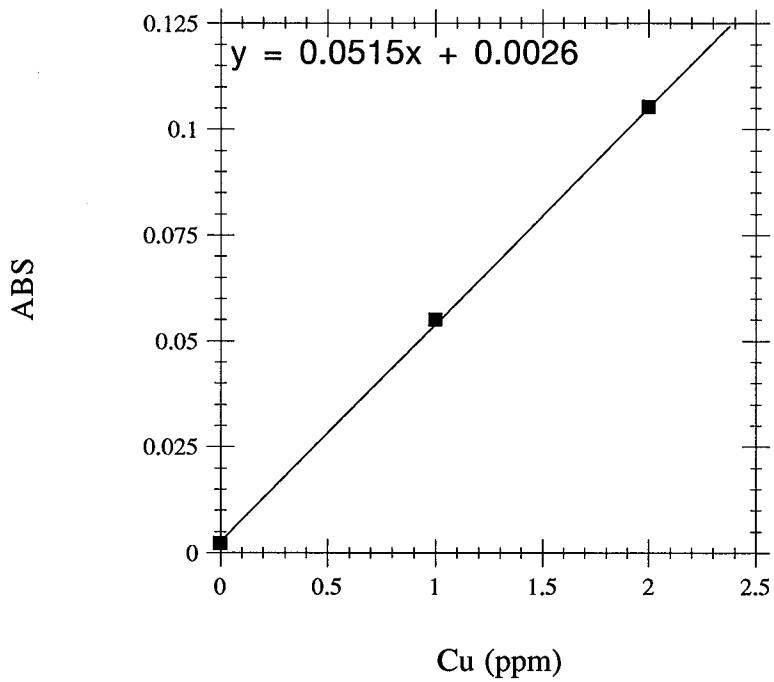
SAN-047




.0327 x 2 = .0654

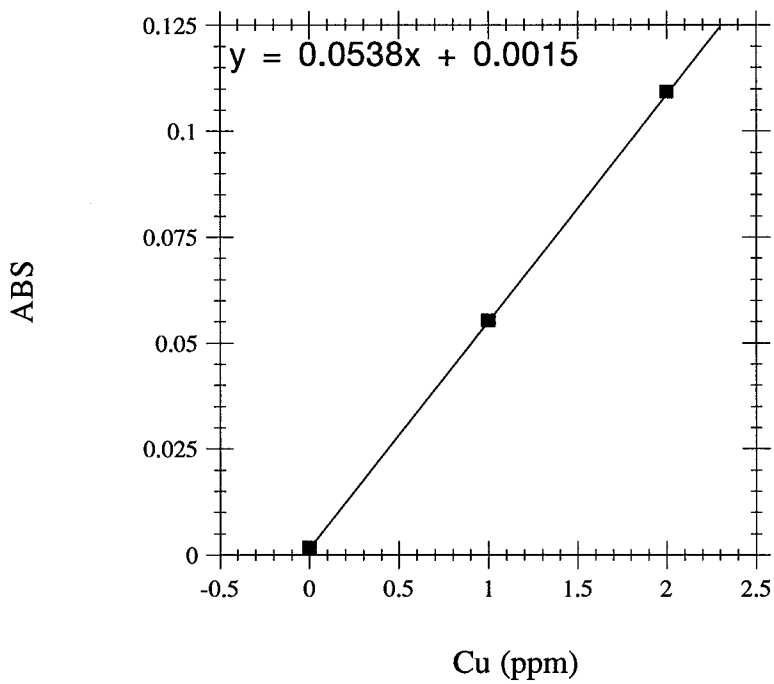
$\frac{.0654 \times 8}{1.0227}$ = .512 ppm

SAN-048 MgCl2



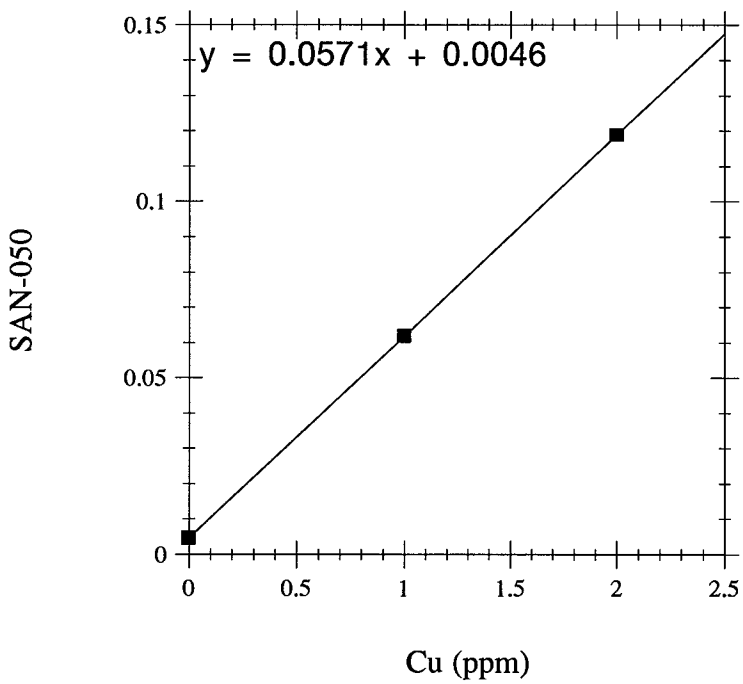

.0505 x 2 = .1010 x 8 / 1.022 = .791 ppm

SAN-049 MgCl2



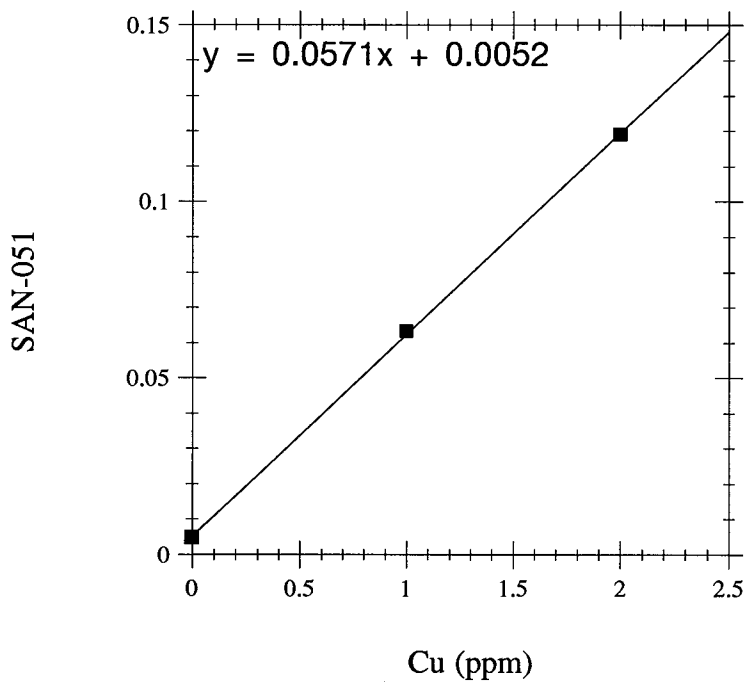

$.0279 \times 2 = .0558 \times \frac{8}{1.017} = .439$ ppm

SAN-050 MgCl2



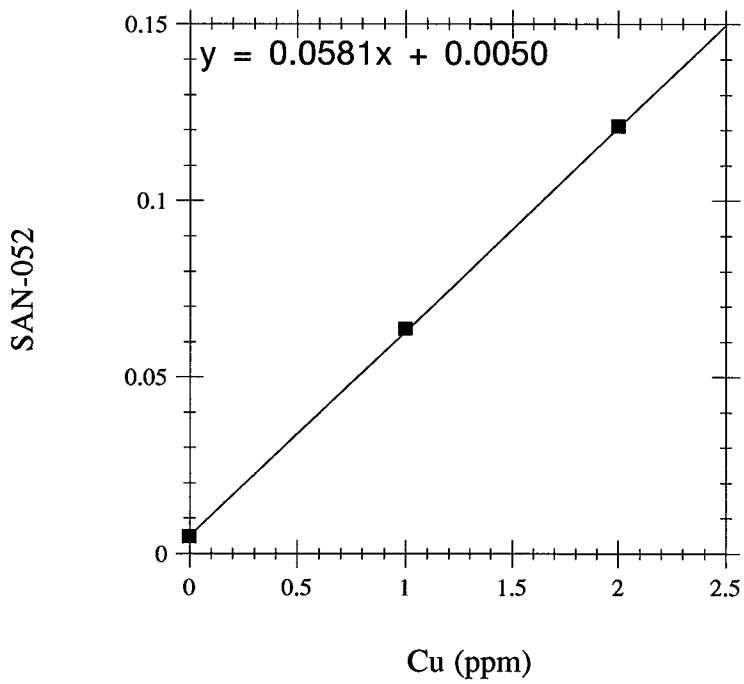

$.0806 \times 2 = .1612 \times \frac{8}{1.016} = 1.269\,ppm$

SAN-051 MgCl2



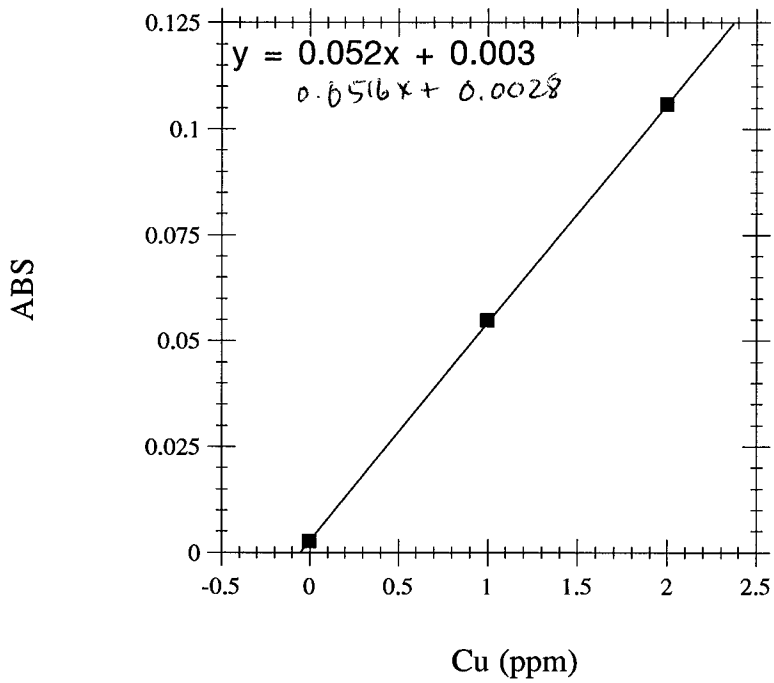

.0910 ÷ 2 = .182 × 8 / 1.017 = 1.432 ppm

SAN-052 MgCl2




$.0861 \times 2 = .1722 \times \frac{8}{1.02} = 1.351 ppm$

SAN-053 MgCl2

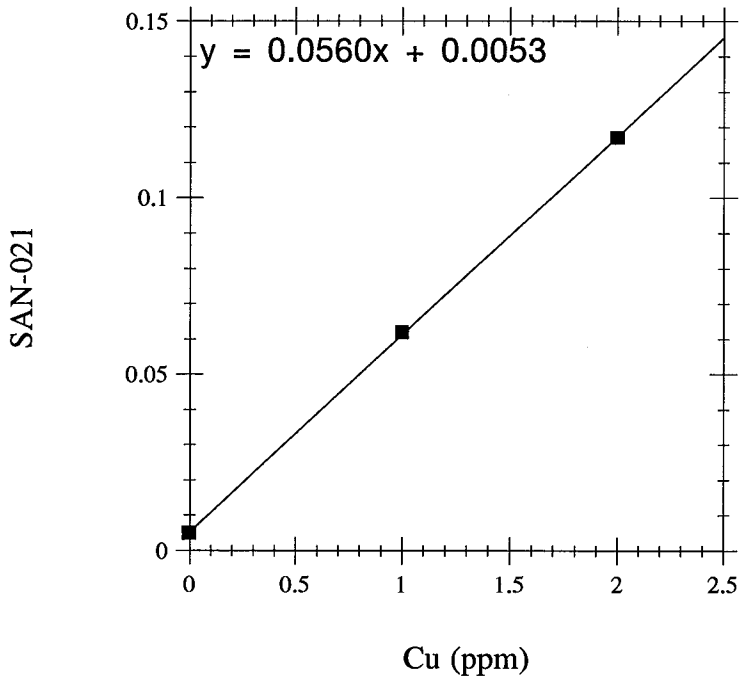



.0543

x2 = .1084

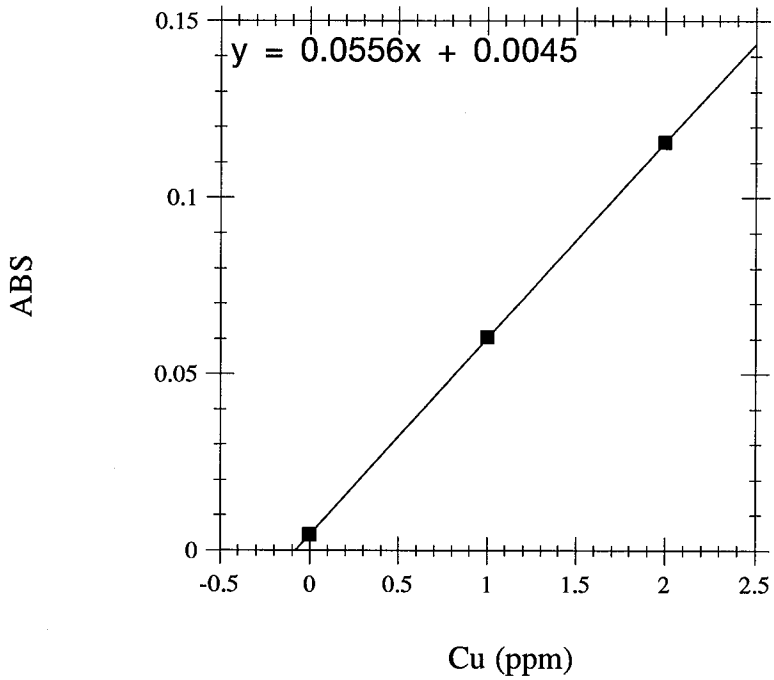
$.1086 \times \frac{8}{1.008} = .862$ ppm

SAN-021 NaOAc




$.0946 \times 2 = .1892 \times \frac{8}{1.016} = 1.489$ ppm

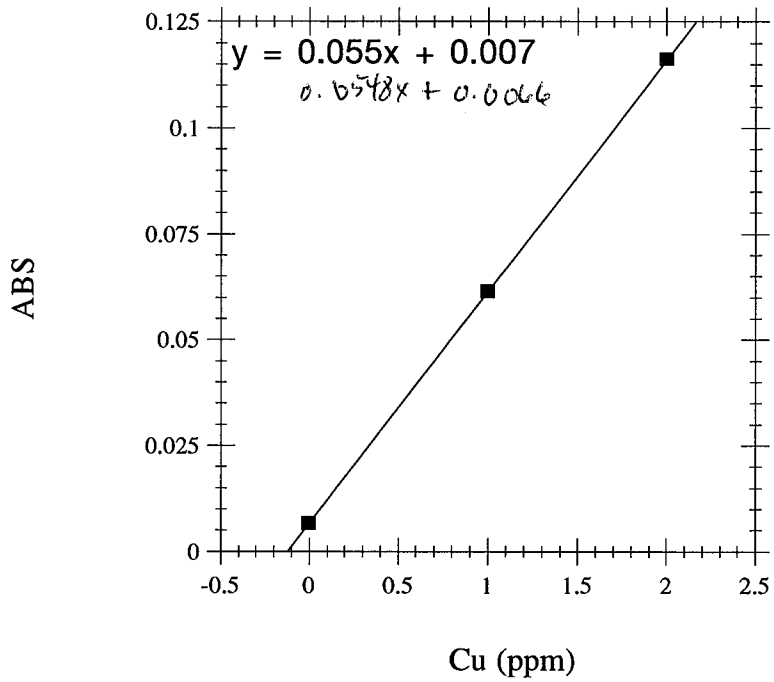
SAN-022 NaOAc




.0809 x2 = .1618

.1618 x 8/1.022 = 1.2266 ppm

SAN-023 NaOAc

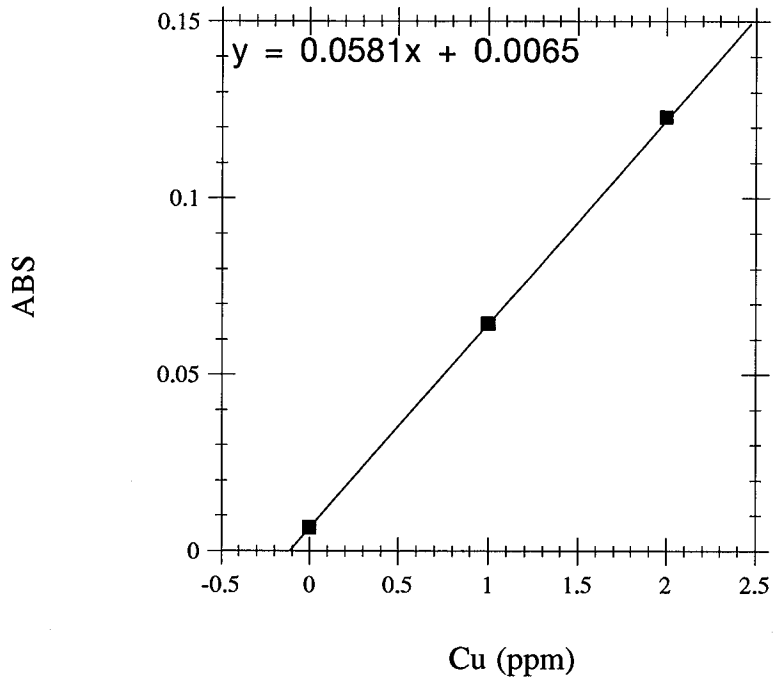



.1204

x2 = .2408

$.2408 \times \frac{8}{1.022} = 1.885$ ppm

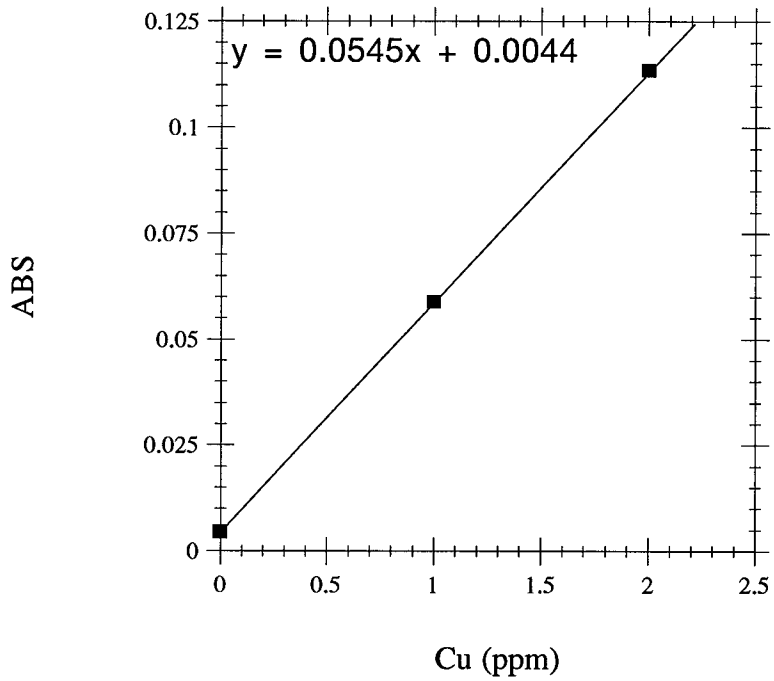
SAN-024 NaOAc




.11188 x 2 = .2238

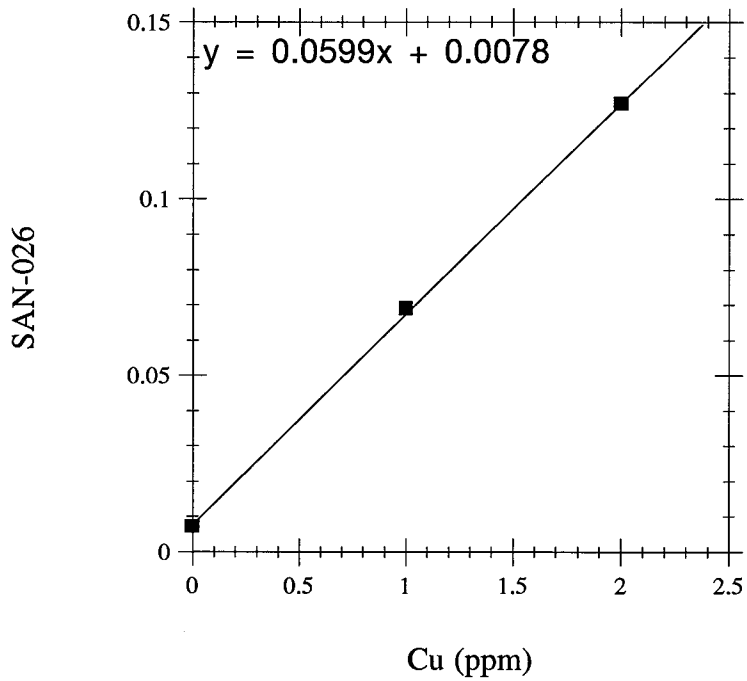
.2238 x 8/1.0183 = 1.759 ppm

SAN-025 NaOAc



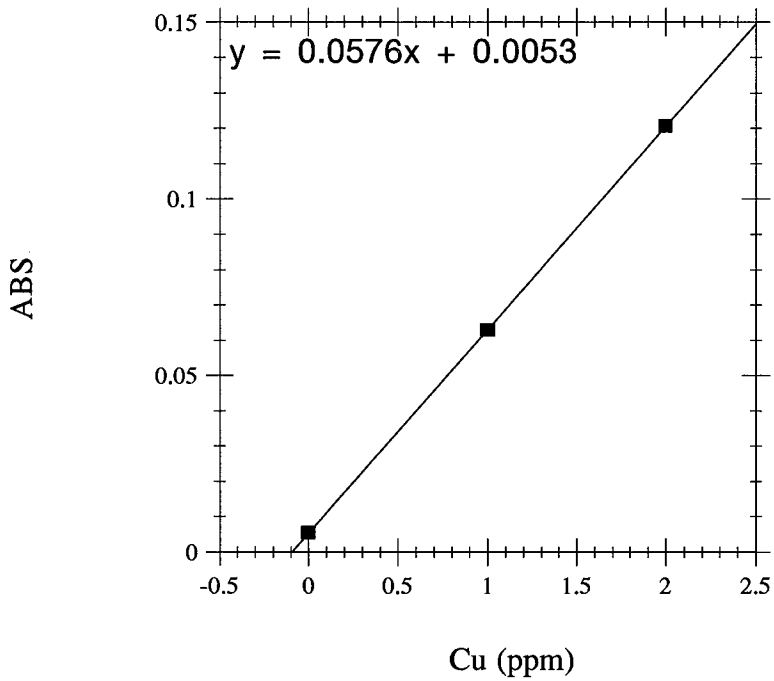

$.0807 \times 2 = .1614 \times \frac{8}{1.025} = \underline{1.26 ppm}$

SAN-026 NaOAc



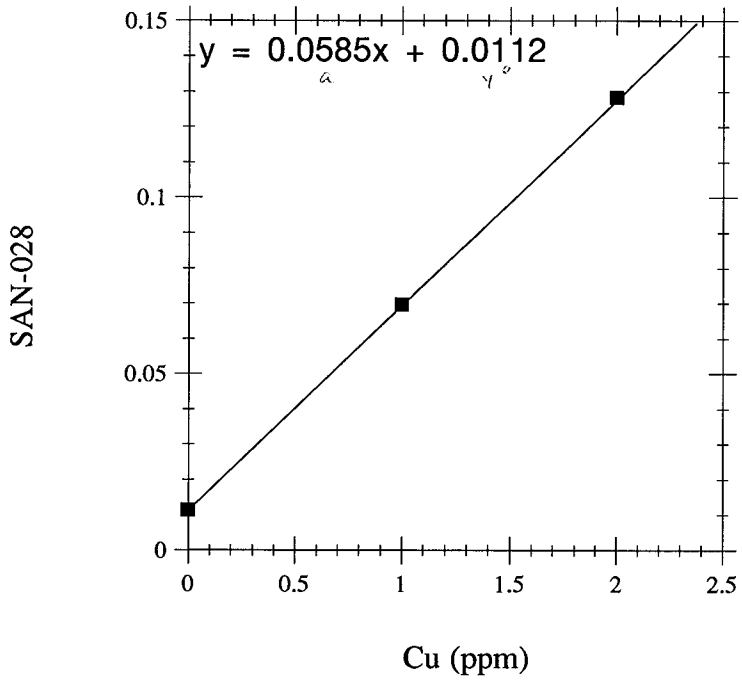

.1302 x 2 = .2604 x 8/1.021 = 2.04 ppm

SAN-027 NaOAc



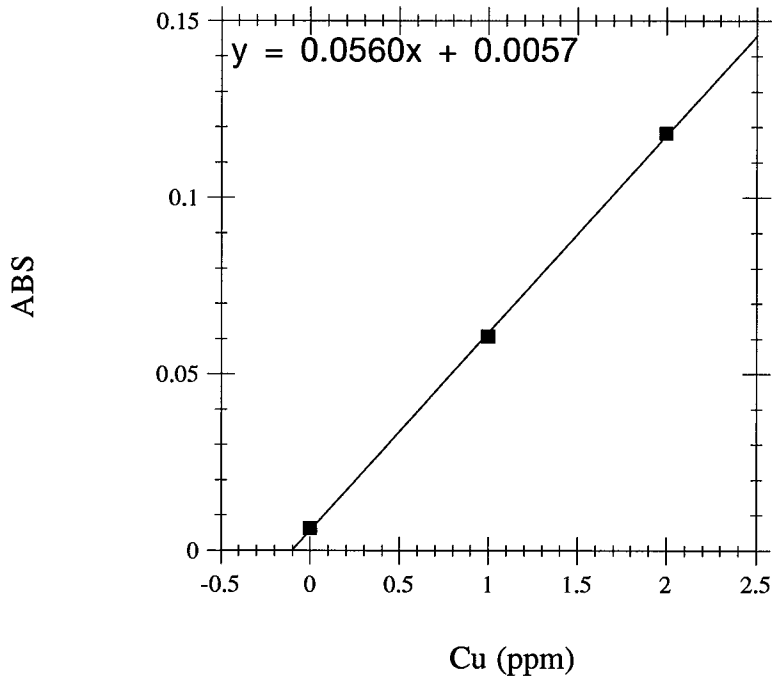

$.092 \times 2 = .184 \times \frac{8}{1.013} = \underline{1.453 \text{ ppm}}$

SAN-028 NaOAc




$.1914 \times 2 = .3828 \times \frac{8}{1.023} = 2.993\,ppm$

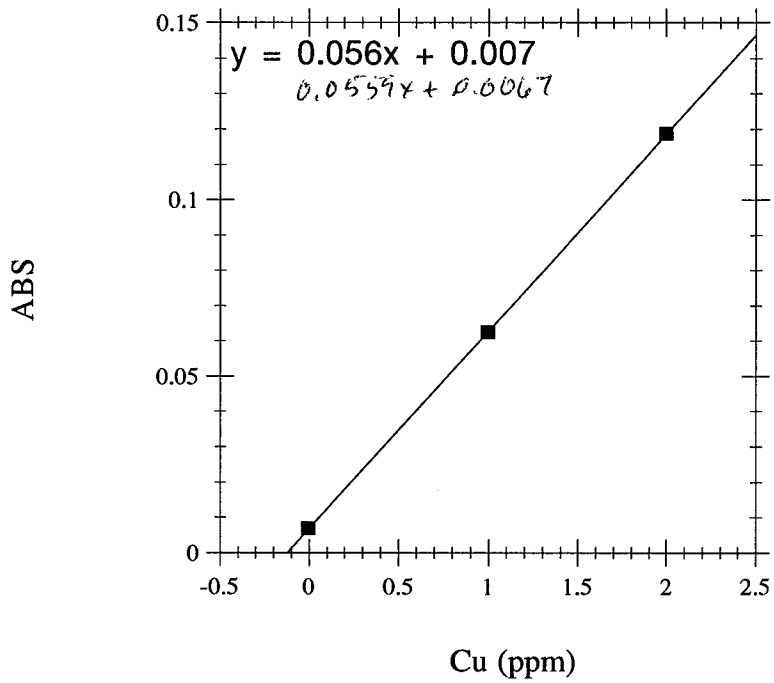
SAN-029 NaOAc




.1018 x 2 = .2036

.2036 x 8/1.020 = 1.597 ppm

SAN-030 NaOAc

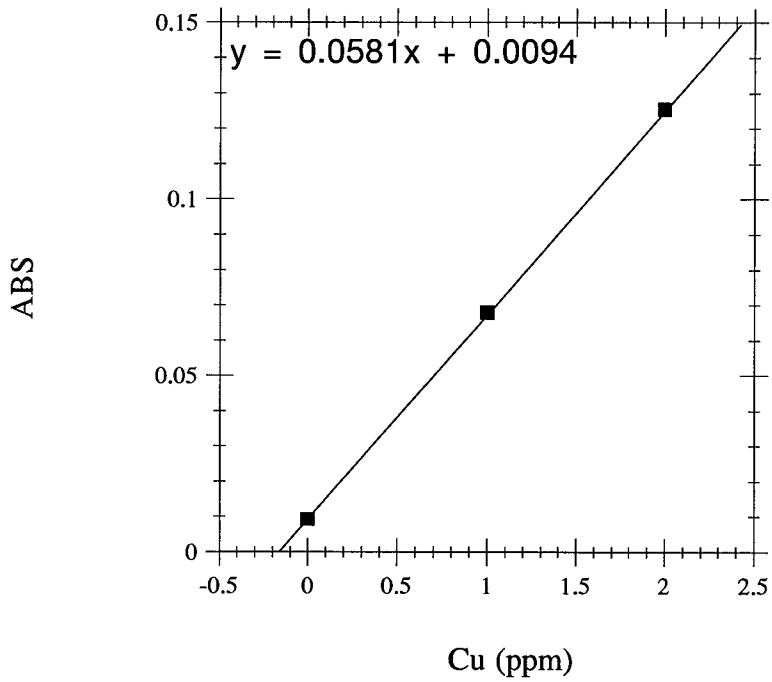



.1198

x2 = .2396

$.2396 \times \frac{8}{1.022} = 1.875$ ppm

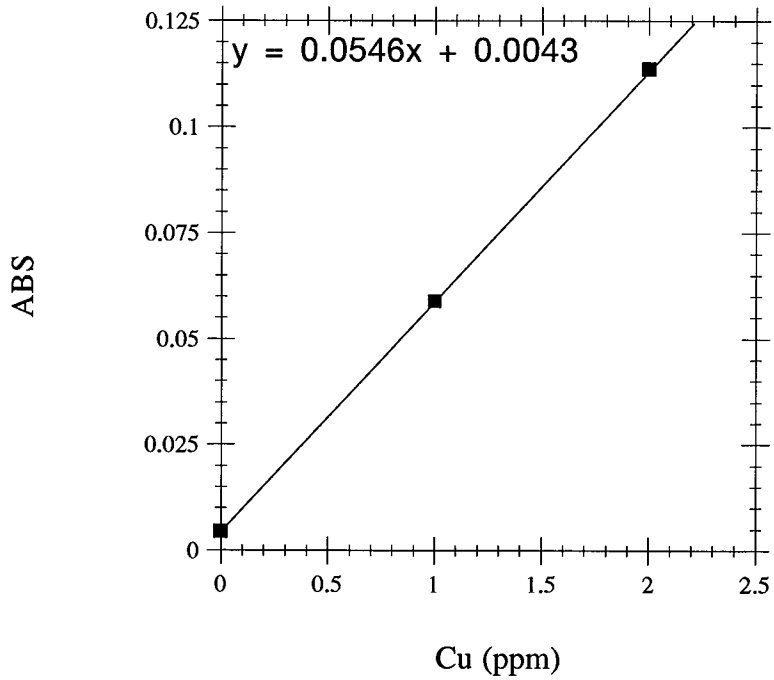
SAN-031 NaOAc




.1618 x 2 = .3236

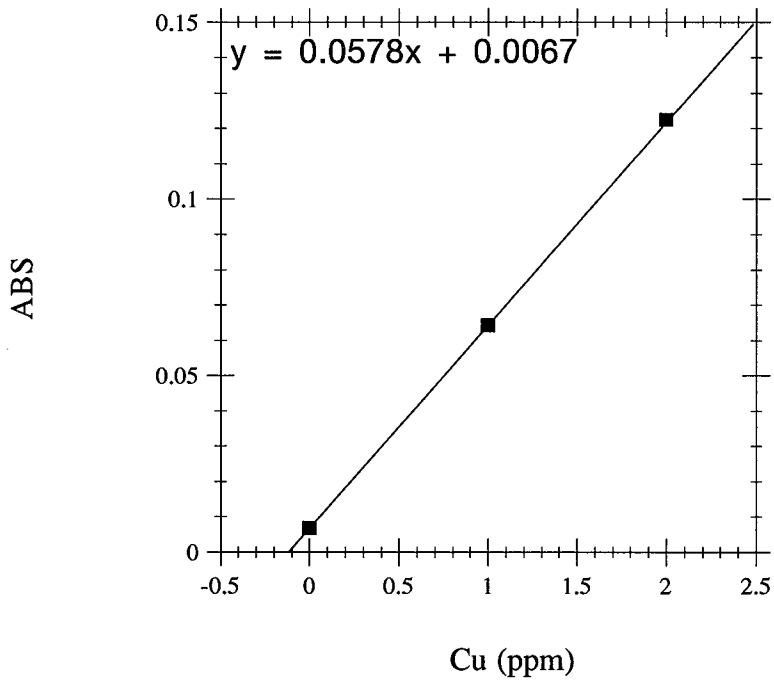
$.3236 + \frac{8}{1.0258} = 2.524$ ppm

SAN-032 NaOAc



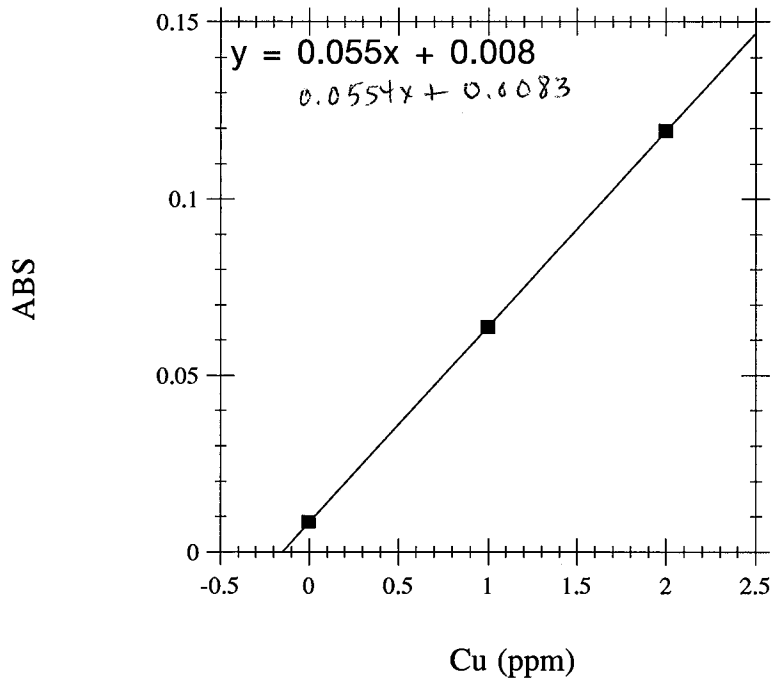

$.0787 \times 2 = .1574 \times \frac{8}{1.017} = 1.238$ ppm

SAN-033 NaOAc




.1159 x 2 = .2318 x 8/1.012 = 1.832 ppm

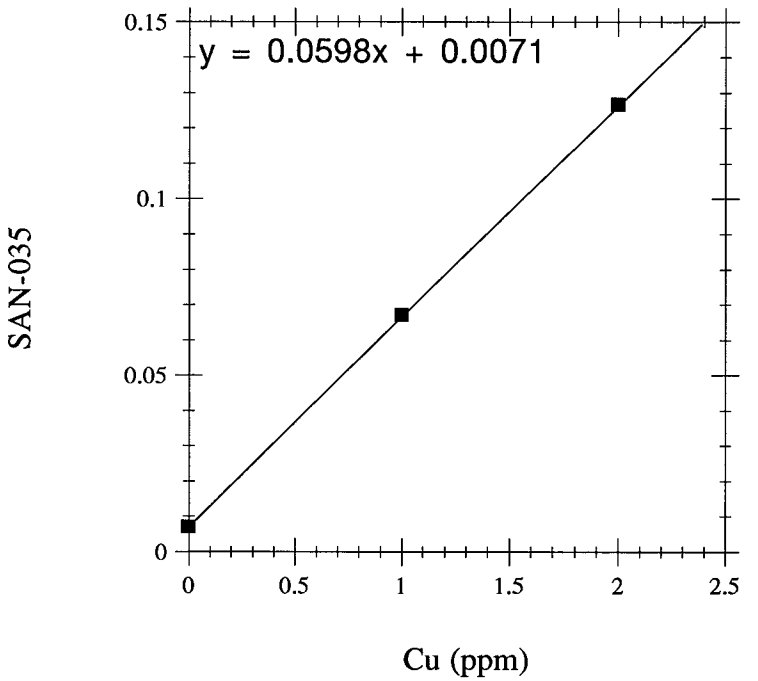
SAN-034 NaOAc




.1498
x2 = .2996

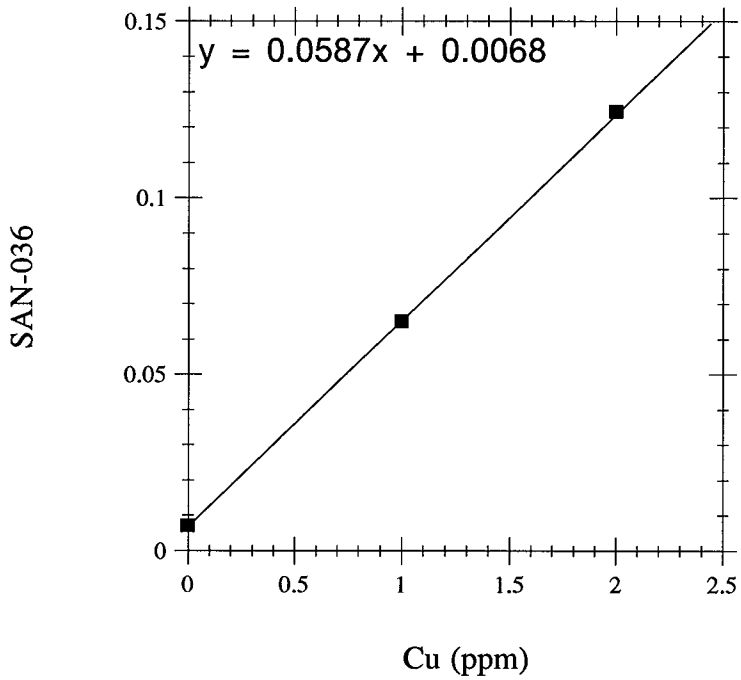
$.2996 \times \frac{8}{1.009} = 2.375$ ppm

SAN-035 NaOAc



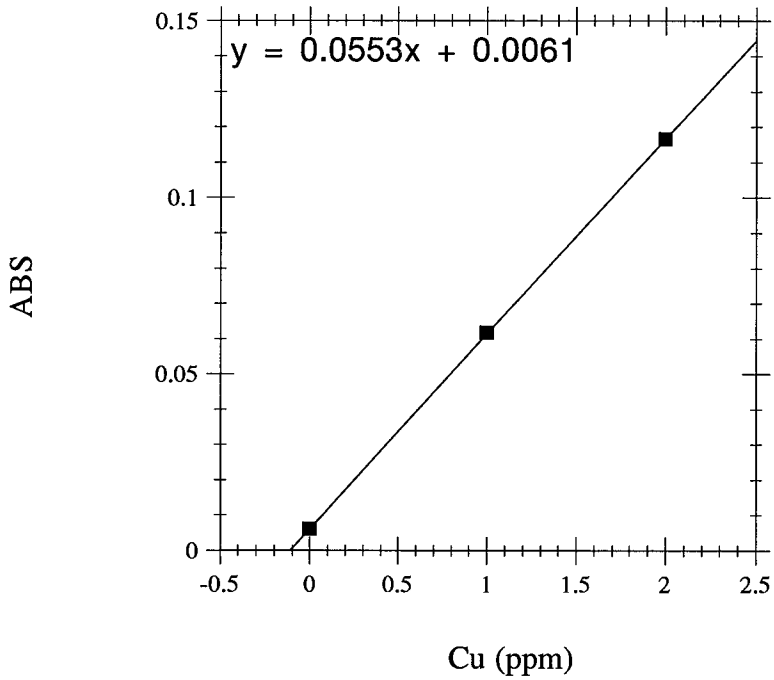

$.1187 \times 2 = .2374 \times \frac{8}{1.02} = 1.862$ ppm

SAN-036 NaOAc




$.1158 \times 2 = .2316 \times \frac{8}{1.014} = 1.827$ ppm

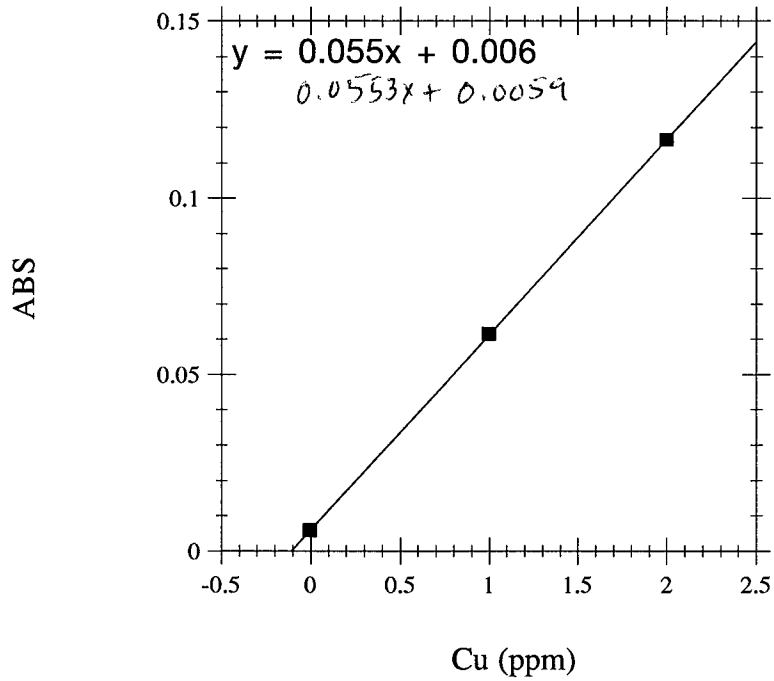
SAN-037 NaOAc




.1103 x 2 = .2206

$.2206 \times \frac{8}{1.021} = 1.728$ ppm

SAN-038 NaOAc

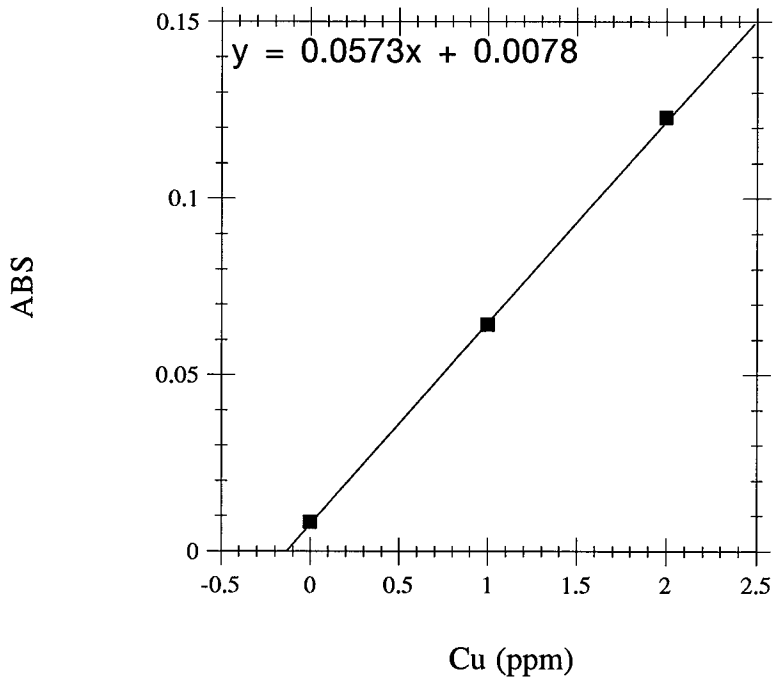



.1067

x2 = .2134

$.2134 \times \frac{8}{1.024} = 1.667$ ppm

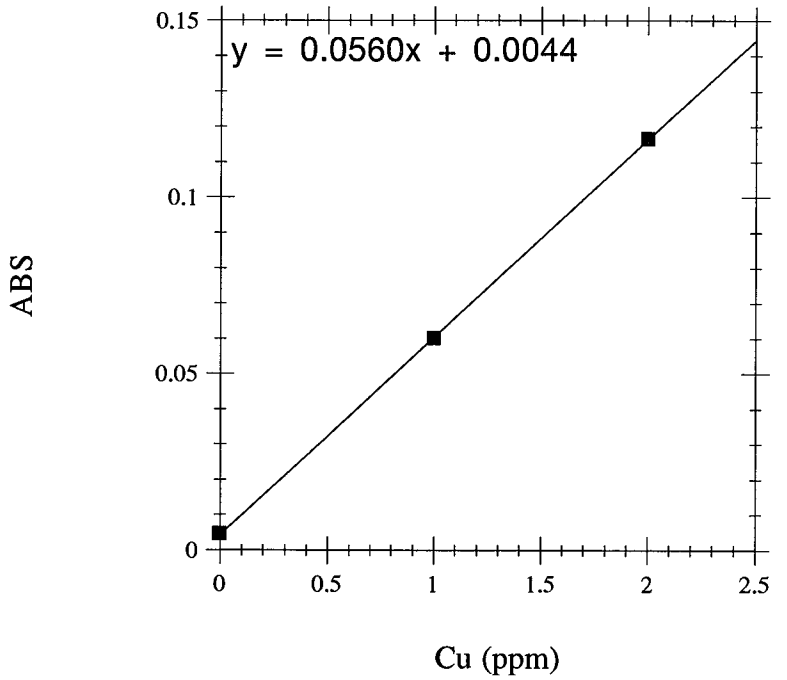
SAN-039 NaOAc




.1361 x 2 = .2722

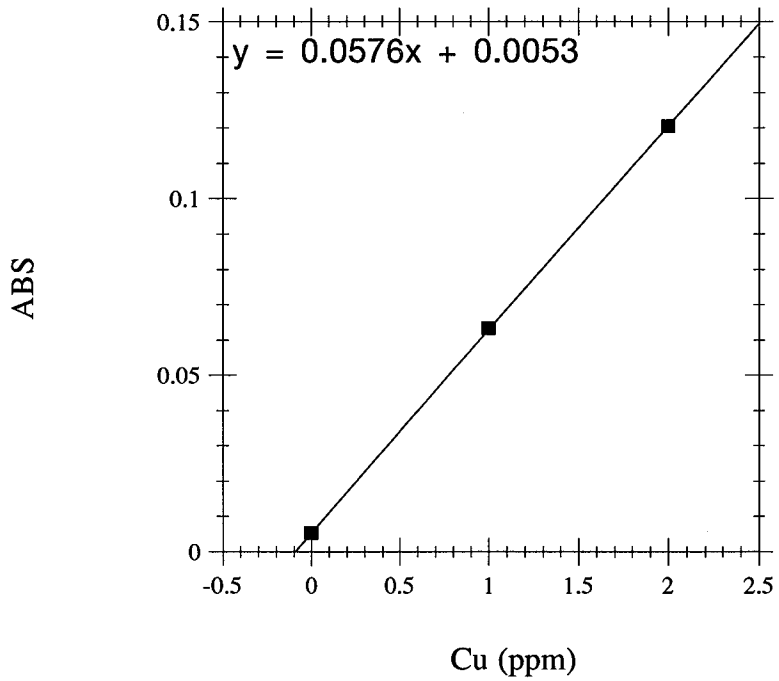
$.2722 \times \frac{8}{1.018} = 2.139$ ppm

SAN-040 NaOAc



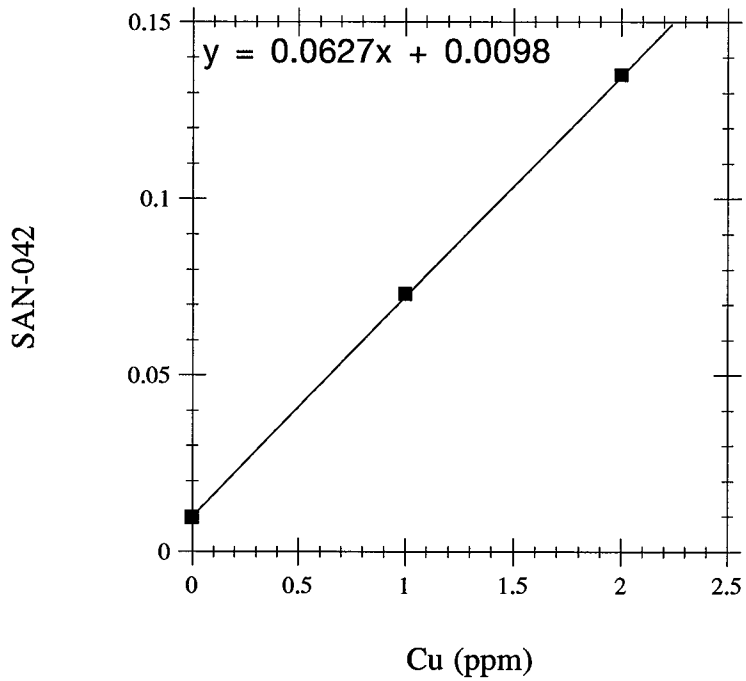

$.0786 \times 2 = .1572 \times \frac{8}{1.017} = 1.236$ ppm

SAN-041 NaOAc



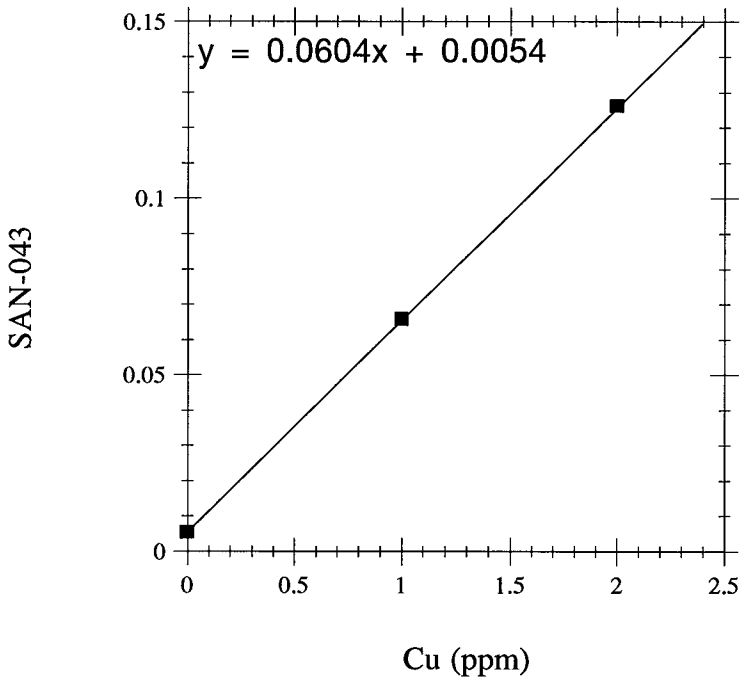

$.092 \times 2 = .184 \times \frac{8}{1.015} = \underline{1.45 \text{ ppm}}$

SAN-042 NaOAc



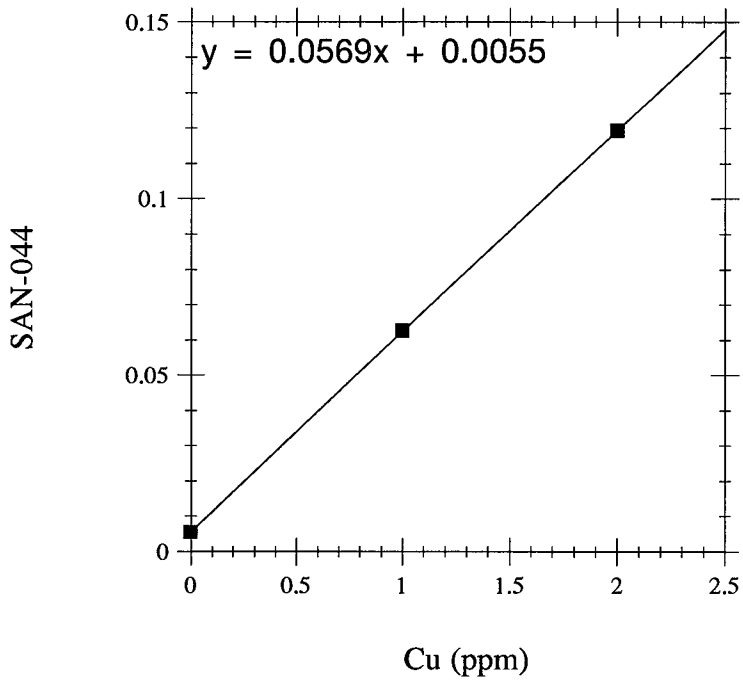

.1563 x 2 = .3126 x 8/1.012 = 2.471 ppm

SAN-043 NaOAc



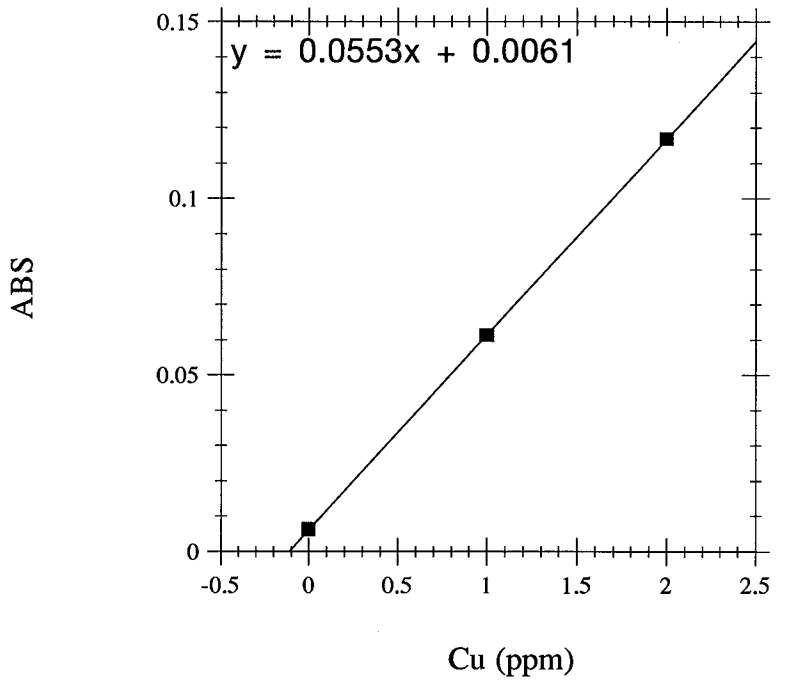

$.0894 \times 2 = .1788 \times \frac{8}{1.022} = 1.3996 \text{ ppm}$

SAN-044 NaOAc




$.0967 \times 2 = .1934 \times \frac{8}{1.014} = 1.526$ ppm

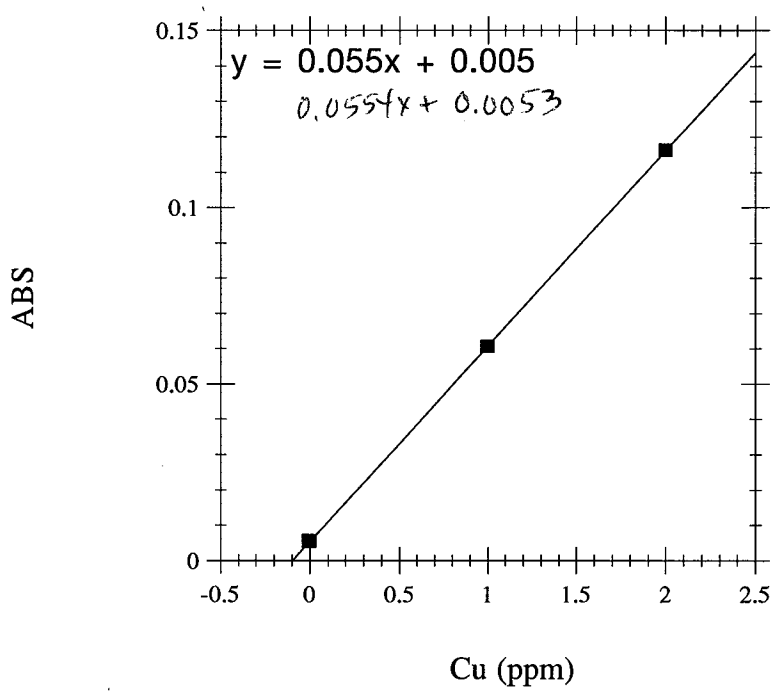
SAN-045 NaOAc




.1103 x 2 = .2206

.2206 x 8/1.021 = 1.728 ppm

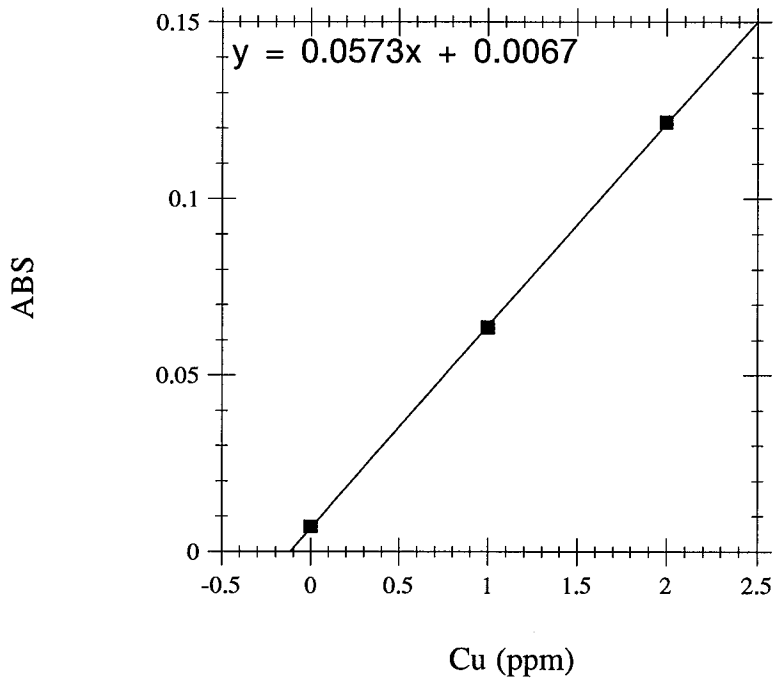
SAN-046 NaOAc




.0957
x2 = .1914

$.1914 \times \frac{8}{1.022} = 1.498$ ppm

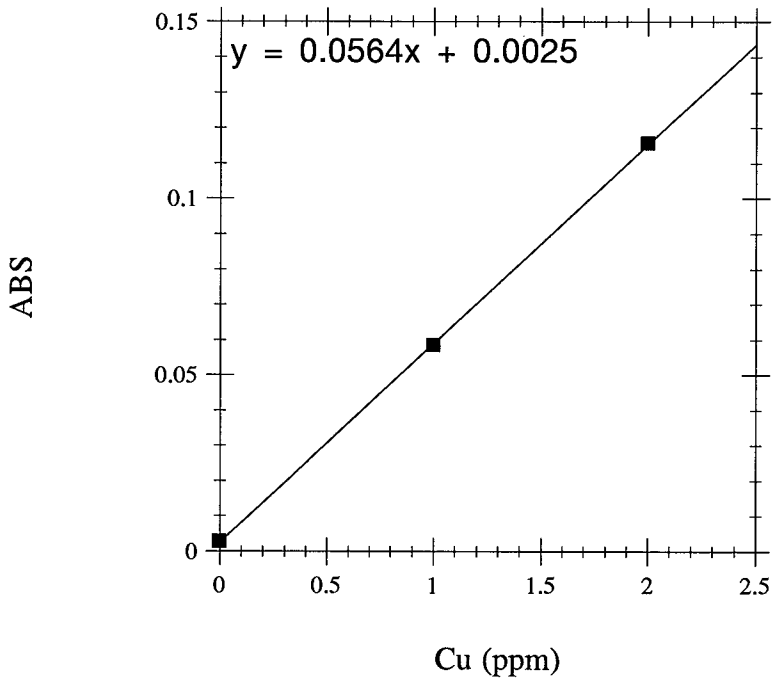
SAN-047 NaOAc




.1169 x 2 = .2338

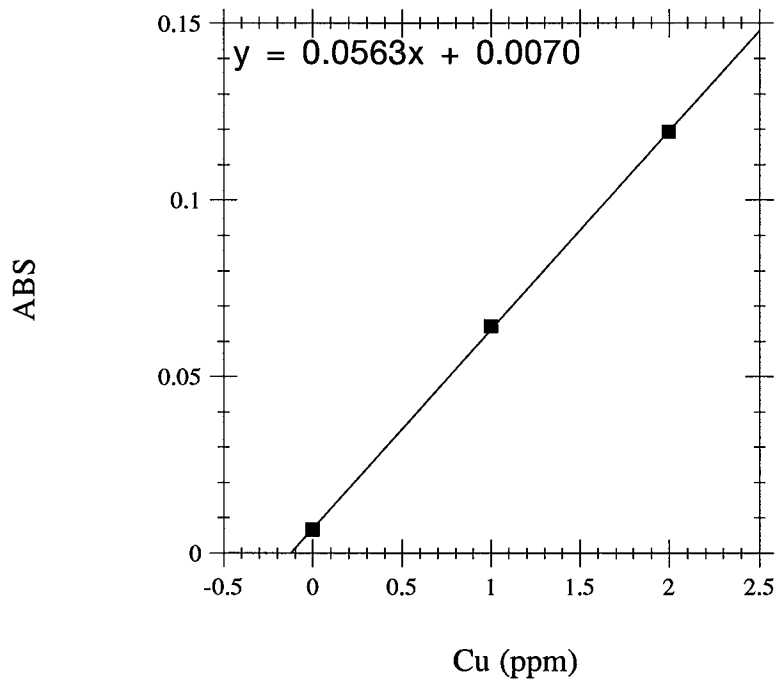
.2338 x 8/1.023 = 1.828 ppm

SAN-048 NaOAc



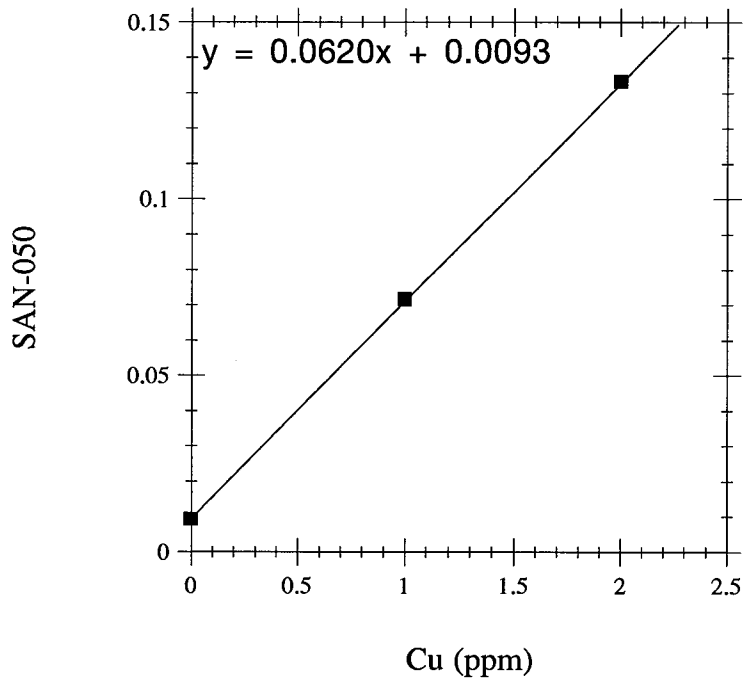

$.6443 \times 2 = .0886 \times \frac{8}{1.022} = .693$ ppm

SAN-049 NaOAc



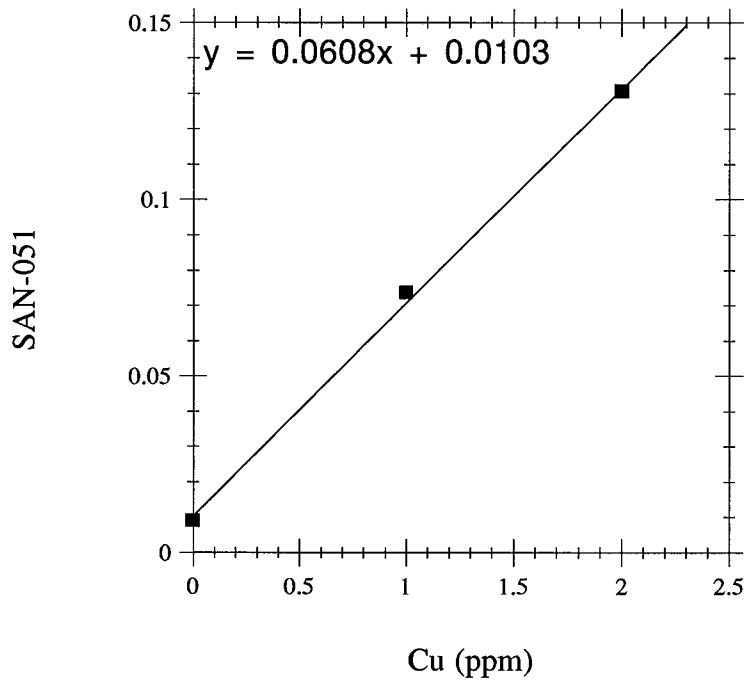

$.1243 \times 2 = .2486 \times \frac{8}{1.017} = 1.955 ppm$

SAN-050 NaOAc



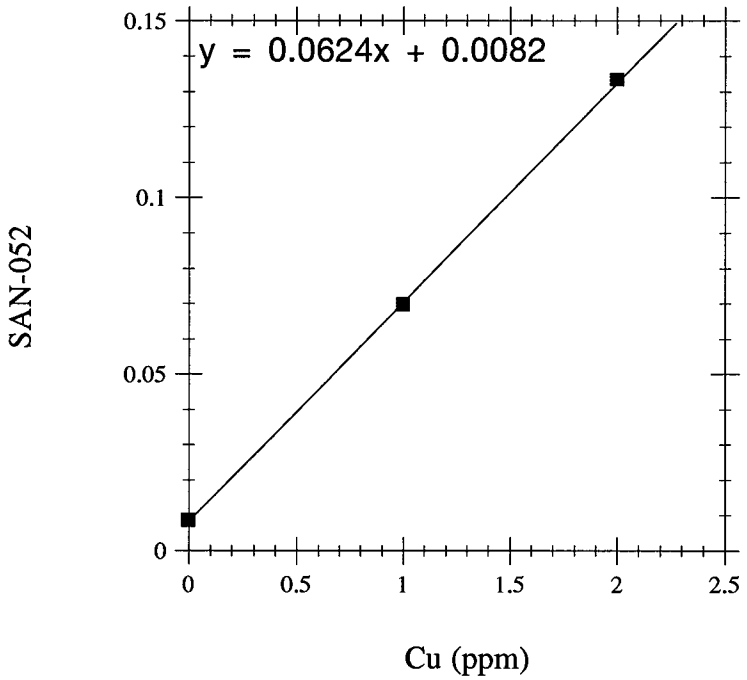

$.15 \times 2 = .3 \times \frac{8}{1.016} = 2.362$ ppm

SAN-051 NaOAc



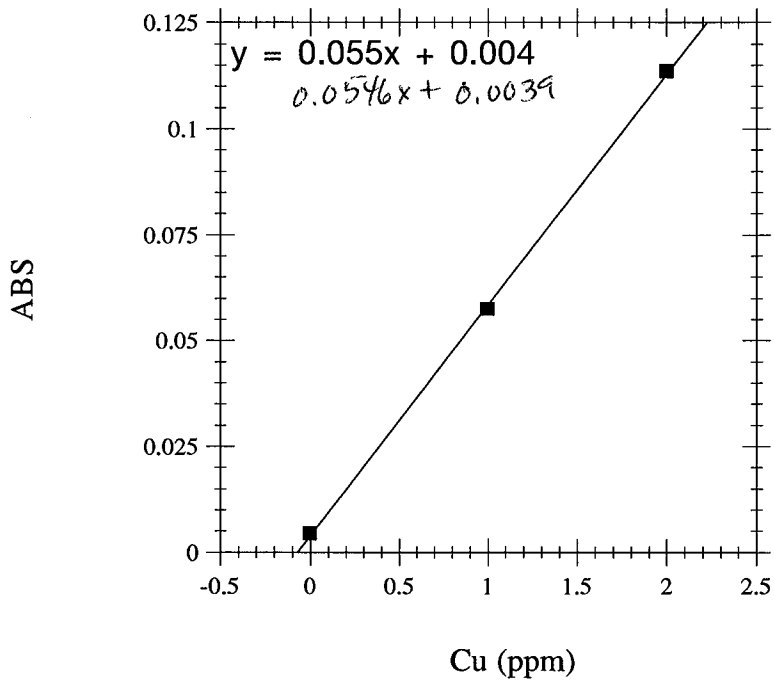

$.1694 \times 2 = .3388 \times \frac{.8}{1.017} = 2.665$ ppm

SAN-052 NaOAc




$.1314 \times 2 = .2628 \times \frac{8}{1.02} = 2.061$ ppm

SAN-053 NaOAc

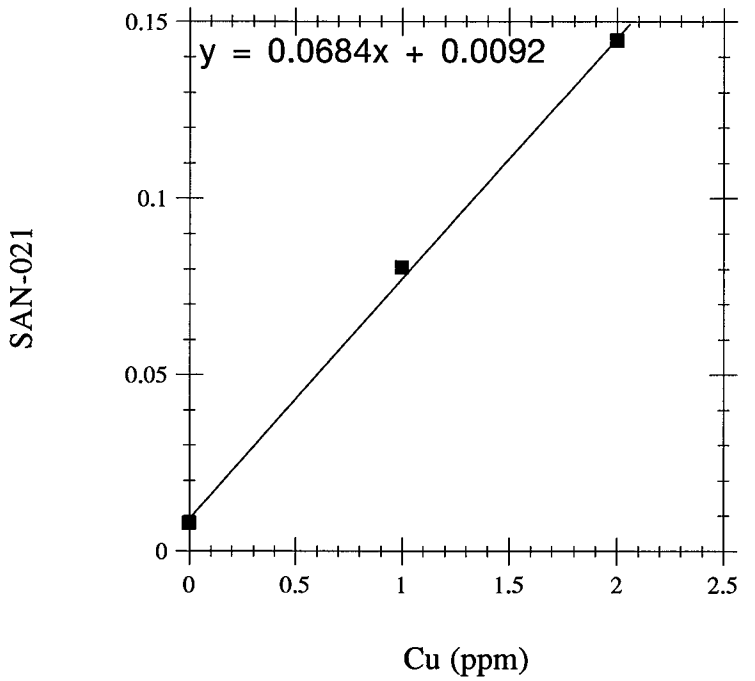



.0714

x2 = .1428

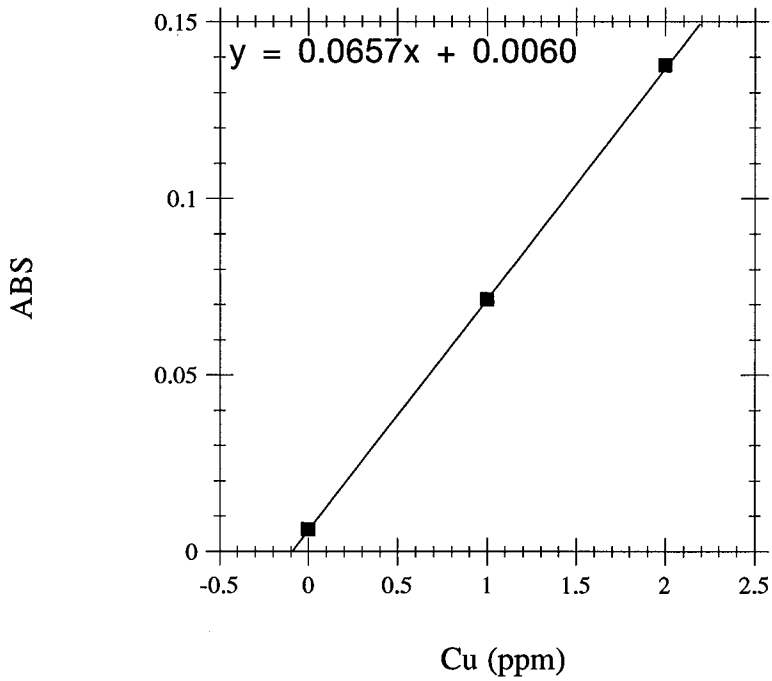
$.1428 \times \frac{8}{1.008} = 1.133$ ppm

SAN-021 NH2OH




$.1345 \times 2 = .269 \times \frac{8}{1.016} = 2.118$ ppm

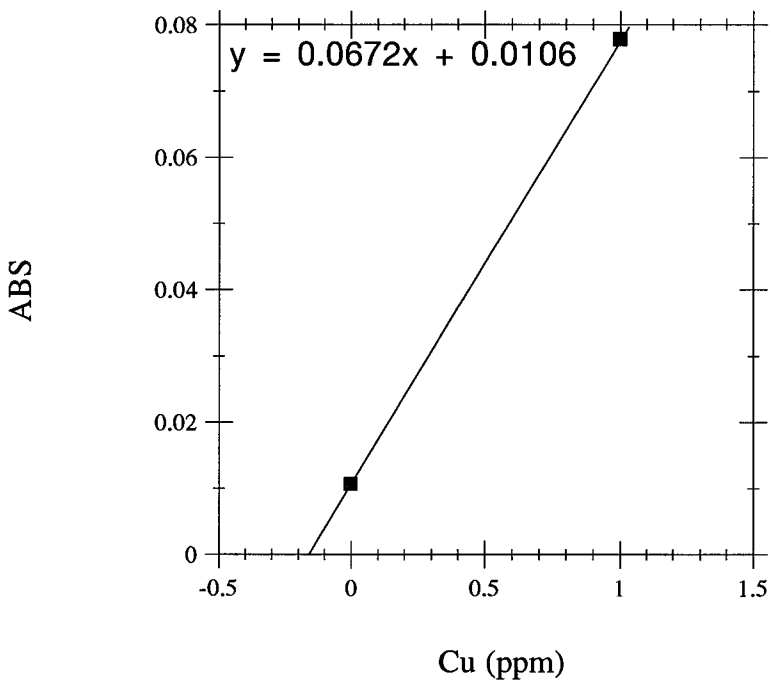
SAN-022 NH2OH




.0913 x 2 = .1826

.1826 x 8/1.022 = 1.429 ppm

SAN-023 NH2OH

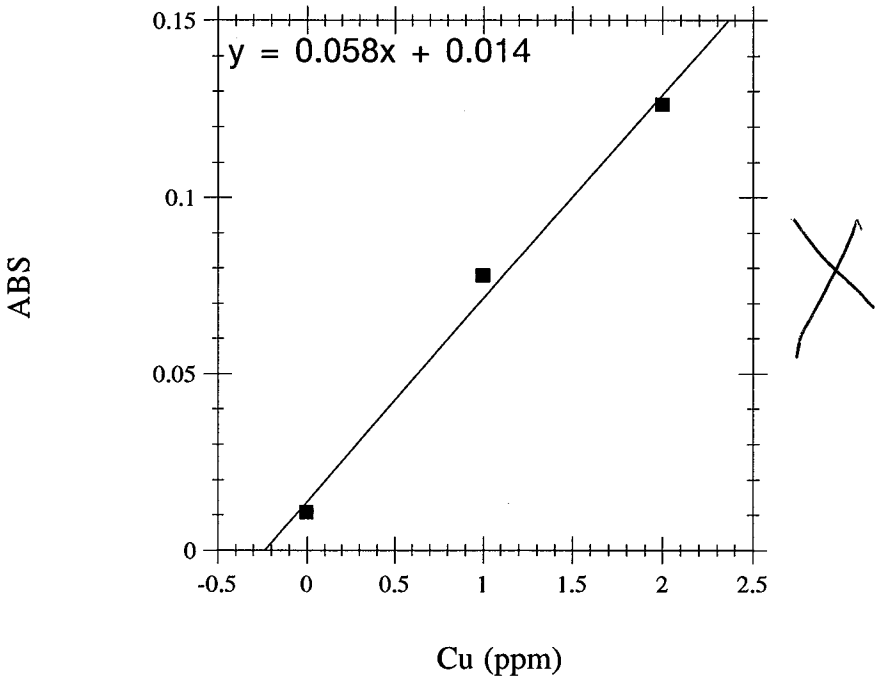



.1577

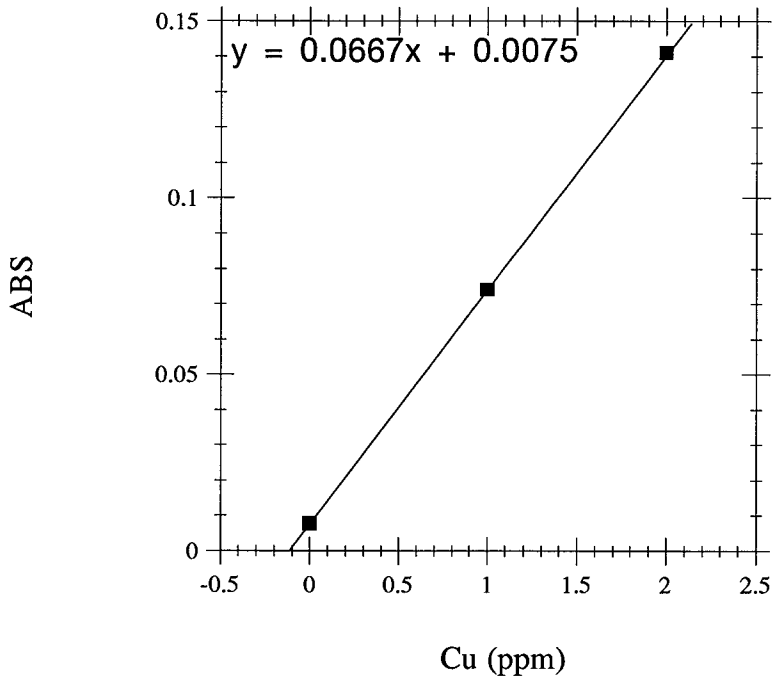
x2 = 0.3154

$.3154 \times \frac{8}{1.022} = 2.469$ ppm

SAN-023 NH2OH



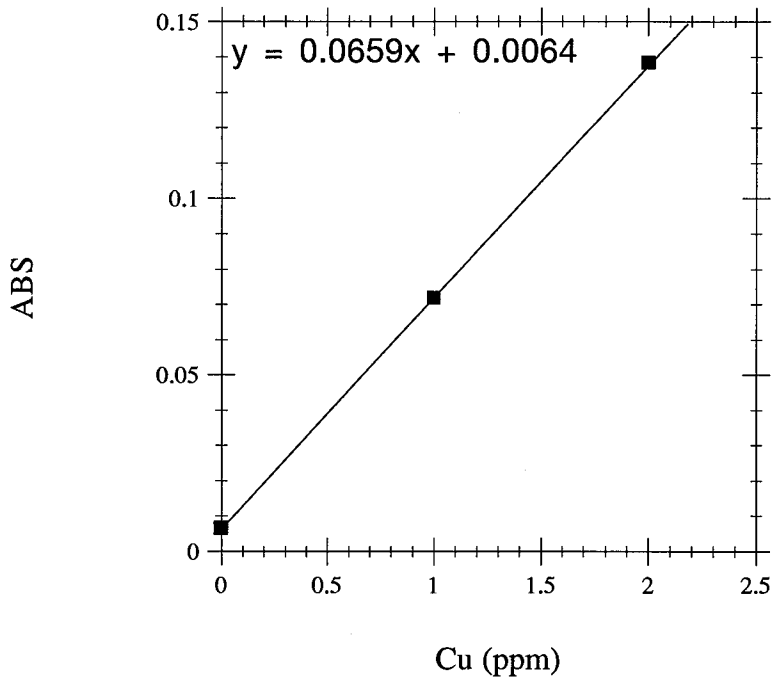
SAN-024 NH2OH




.1124 x 2 = .2248

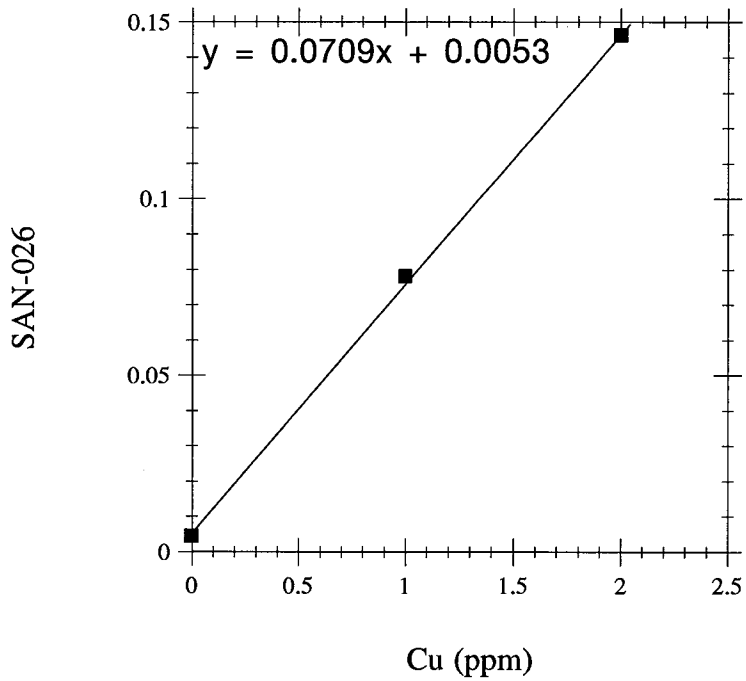
.2248 + 8/1.018 = 1.767 ppm

SAN-025 NH2OH



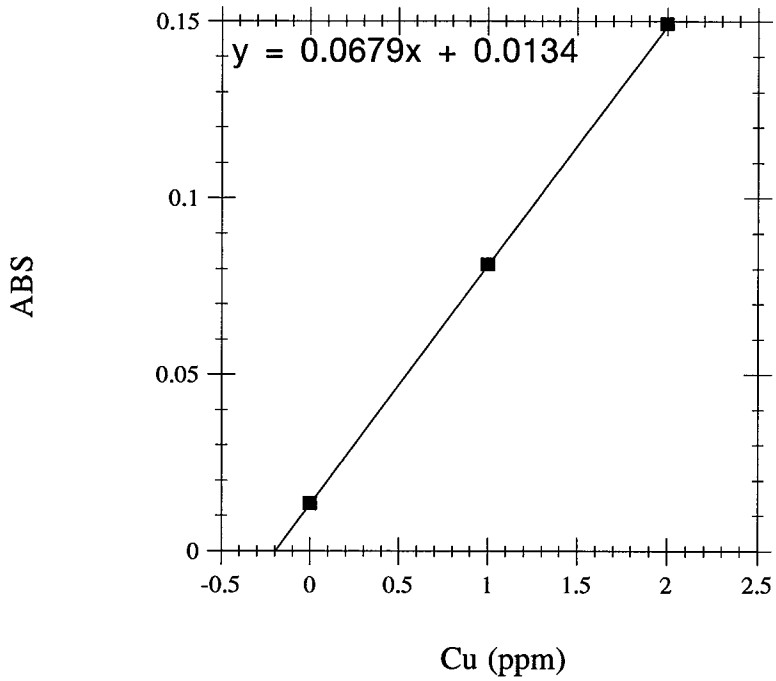

$.09710 \times 2 = .19424 \times \frac{8}{1.025} = \underline{1.516 \text{ ppm}}$

SAN-026 NH2OH



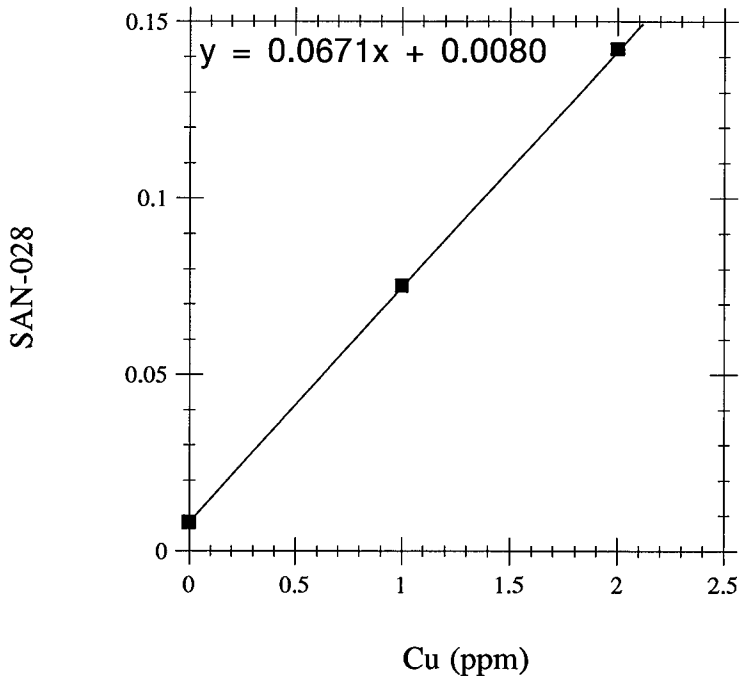

$.0747 \times 2 = .1494 \times \frac{8}{1.021} = 1.171$ ppm

SAN-027 NH2OH



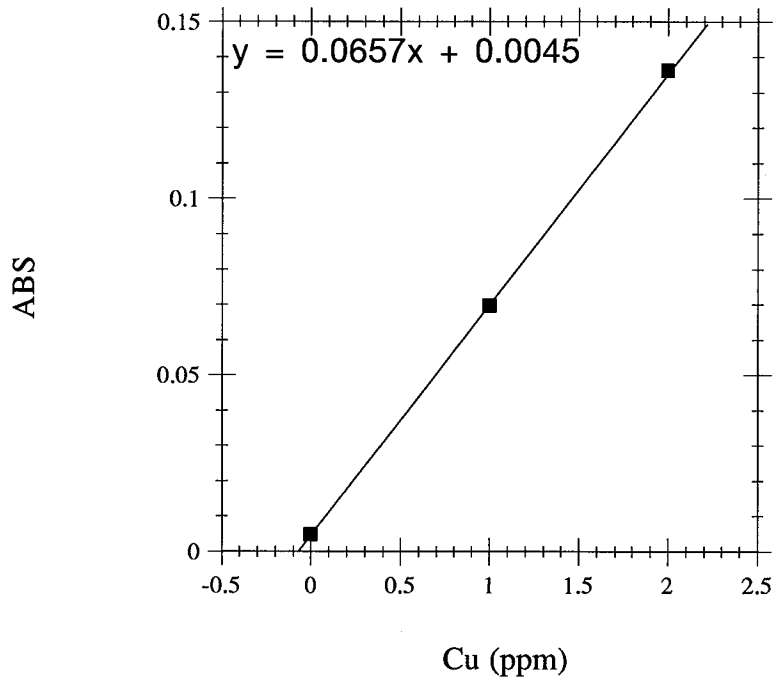

$.1973 \times 2 = .3946 \times \frac{8}{1.013} = \underline{3.116 \text{ ppm}}$

SAN-028 NH2OH




$.1192 \times 2 = .2384 \times 8 / 1.023 = 1.864$ ppm

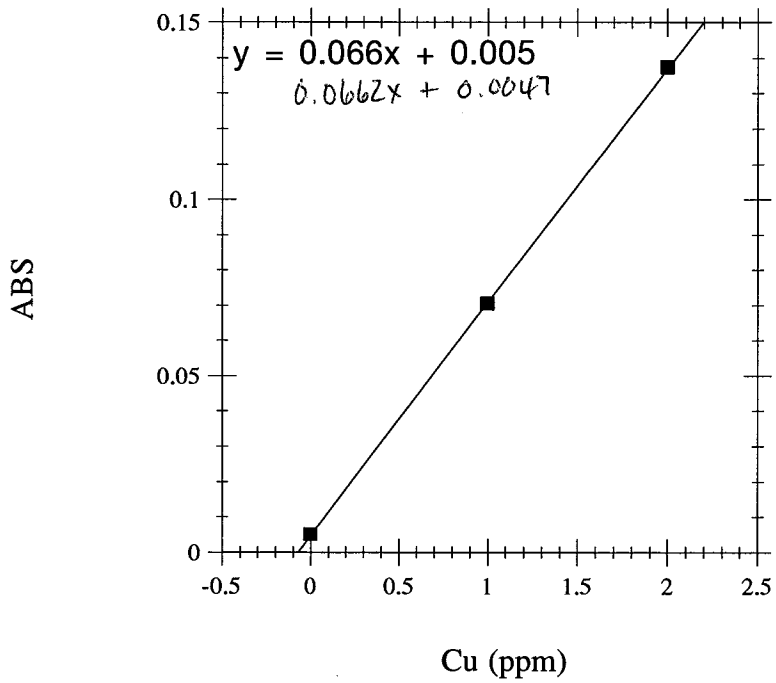
SAN-029 NH2OH




.0685 x 2 = .137

$.137 \times \frac{8}{1.020} = 1.074$ ppm

SAN-030 NH2OH

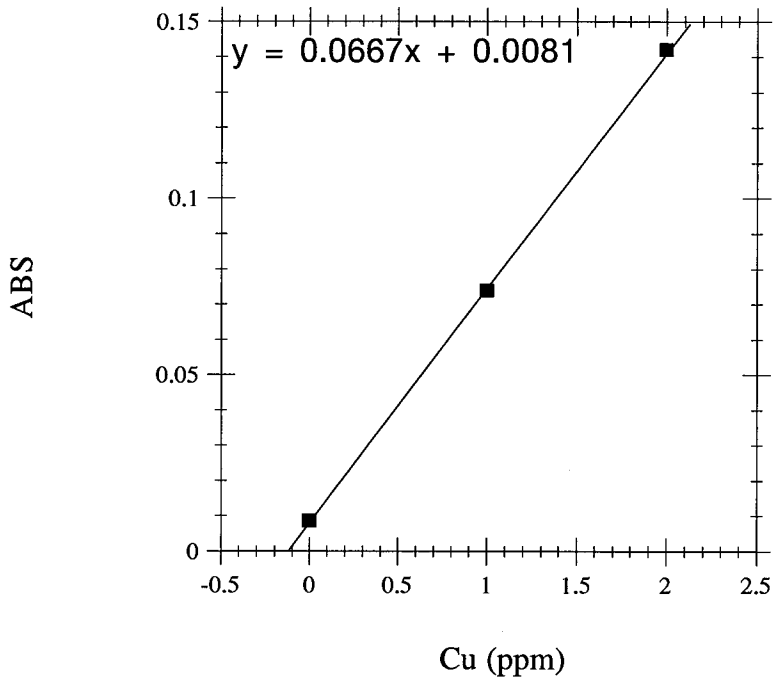



.071

x2 = .142

$.142 \times \frac{8}{1.022} = \underline{1.111 \text{ ppm}}$

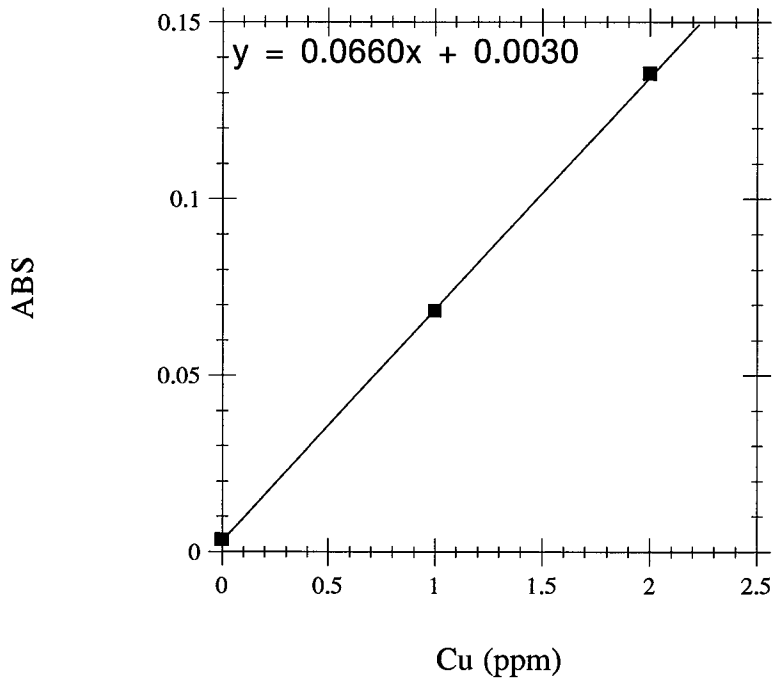
SAN-031 NH2OH




.1214 x 2 = .2428

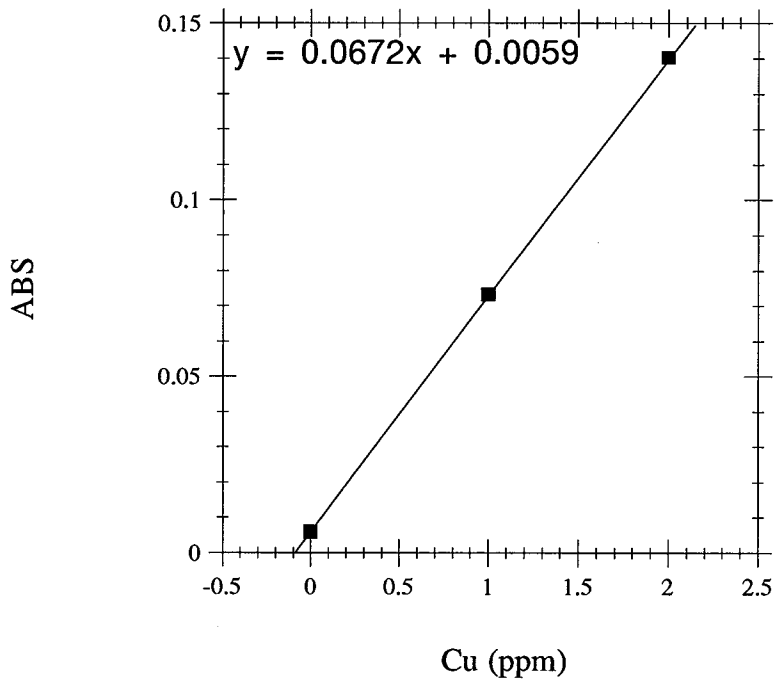
.2428 x 8/1.026 = 1.893 ppm

SAN-032 NH2OH



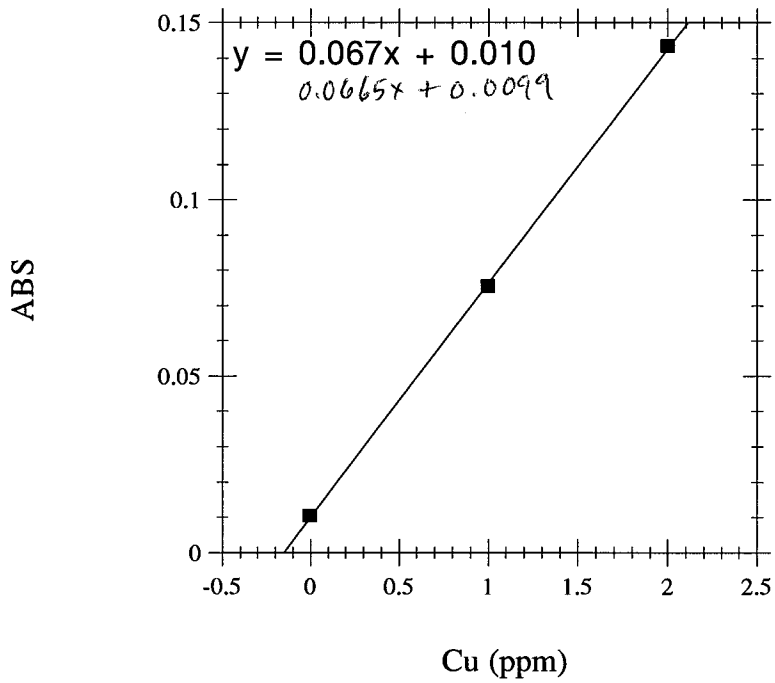

$.0454 \times 2 = .0908 \times \frac{8}{1.017} = .714$ ppm

SAN-033 NH2OH




$.0878 \times 2 = .1756 \times \frac{8}{1.012} = 1.388$ ppm

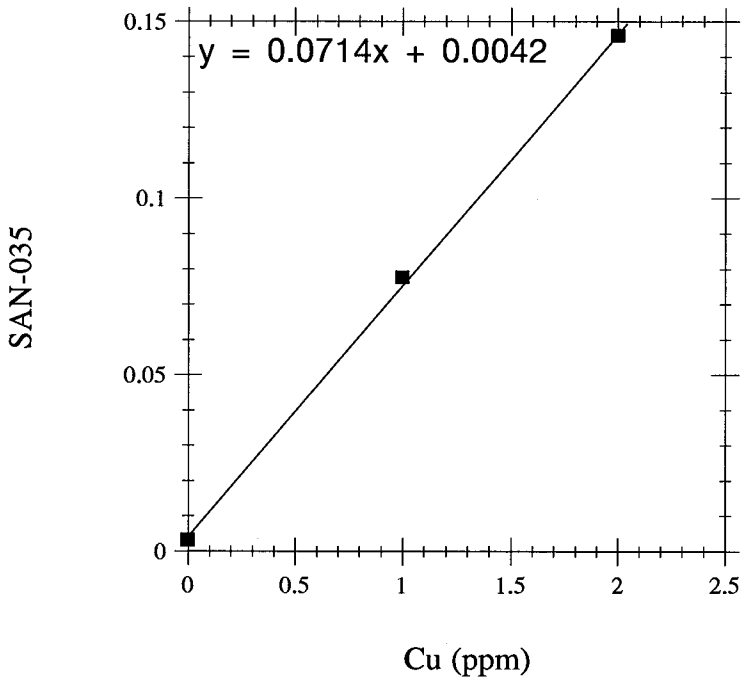
SAN-034 NH2OH




.1489
x2 = .2978

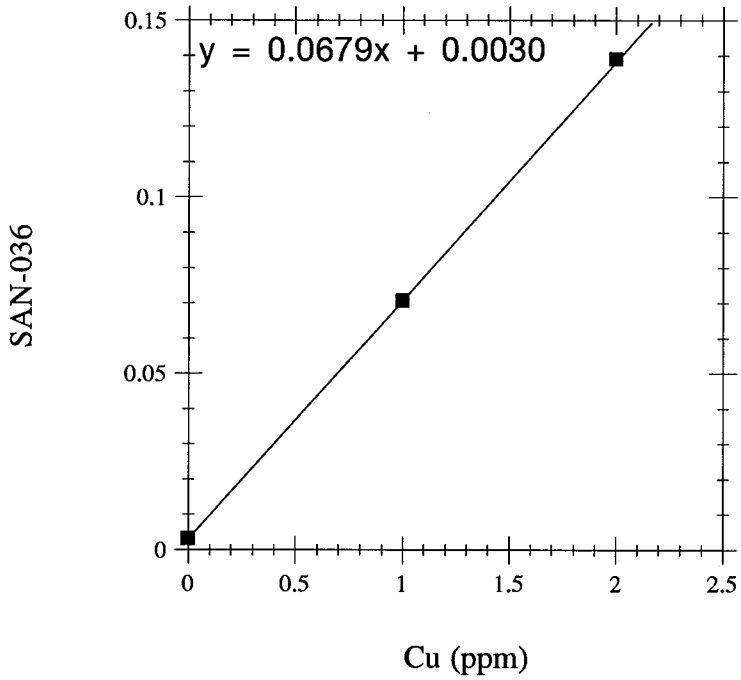
$.2978 \times \frac{8}{1.009} = 2.361 ppm$

SAN-035 NH2OH



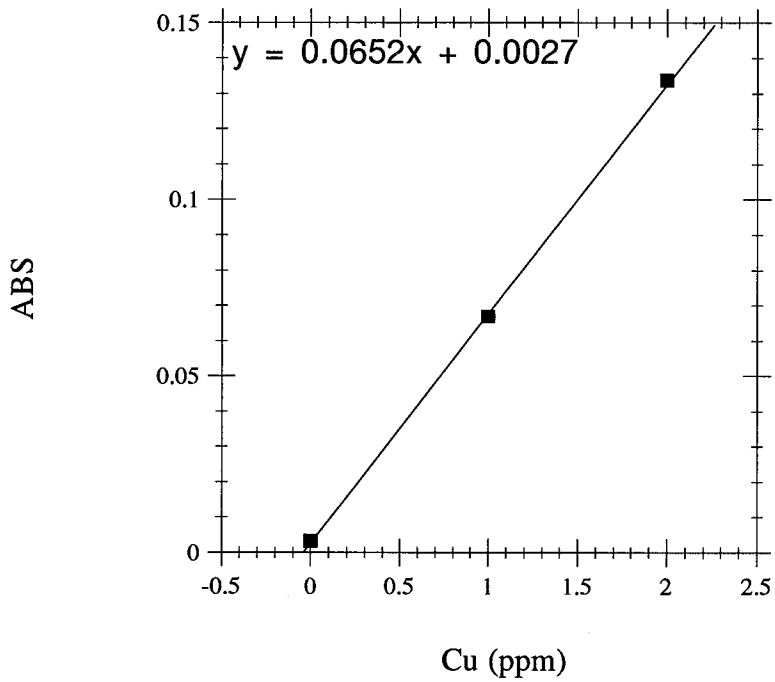

$.0588 \times 2 = .1176 \times \frac{8}{1.02} = .922 \text{ ppm}$

SAN-036 NH2OH




$.0442 \times 2 = .0884 \times \frac{8}{1.014} = .697$ ppm

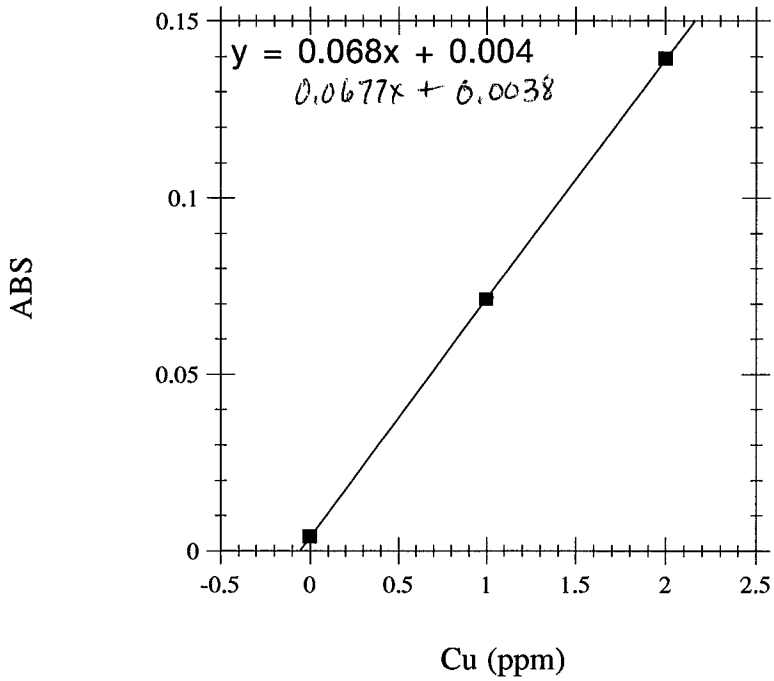
SAN-037 NH2OH




.0414 x 2 = .0828

.0828 x 8/1.021 = .649 ppm

SAN-038 NH2OH

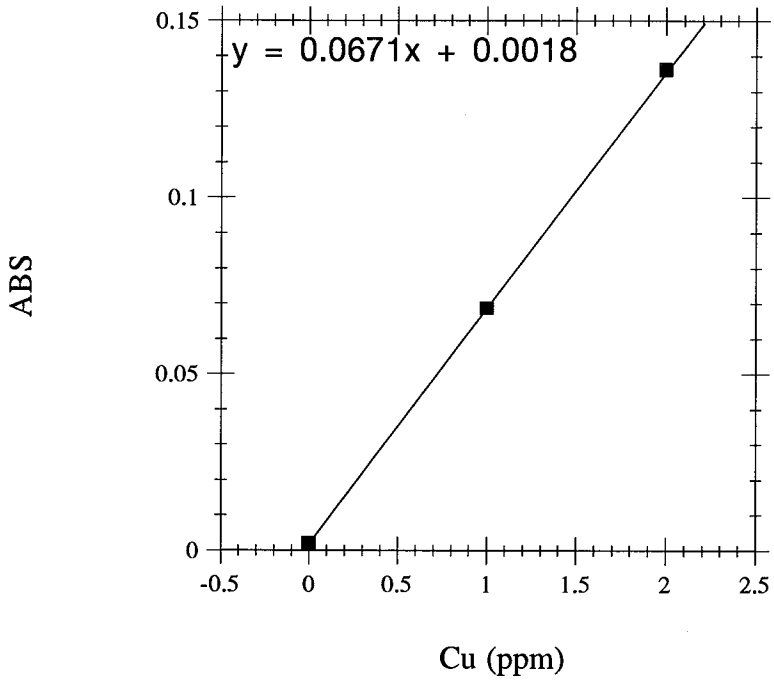



.0561

x2 = .1122

$.1122 \times \frac{8}{1.024} = .876$ ppm

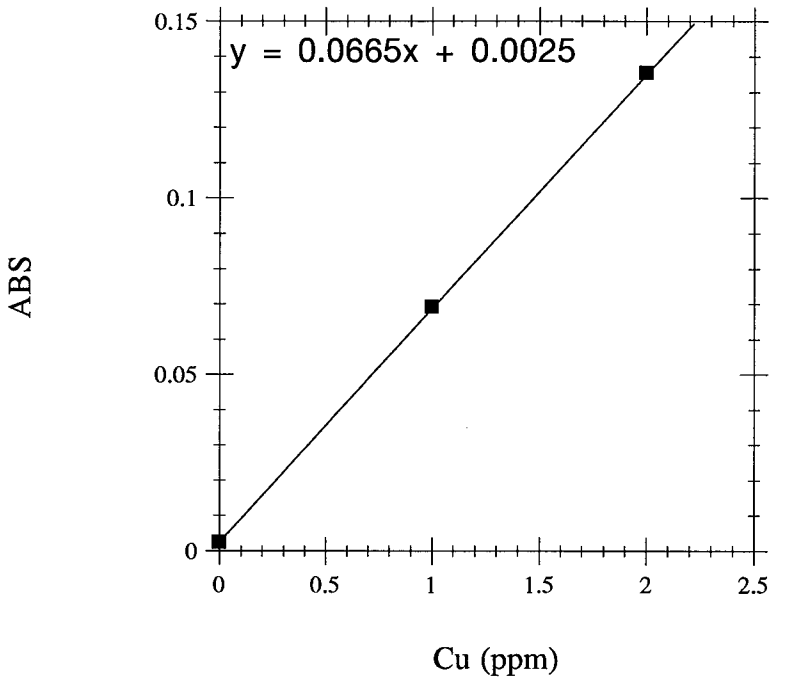
SAN-039 NH2OH




.0268 x 2 = .0536

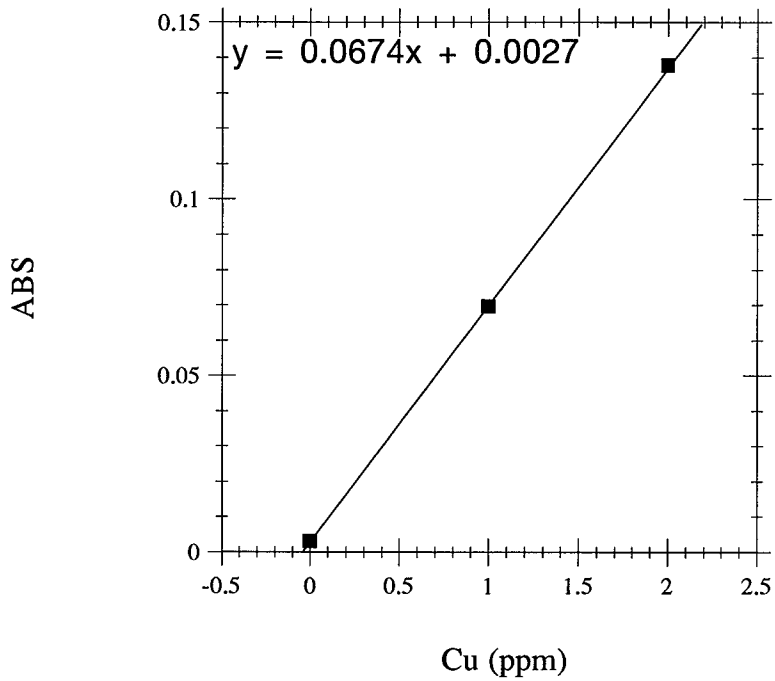
.0536 x 8 / 1.018 = .421 ppm

SAN-040 NH2OH



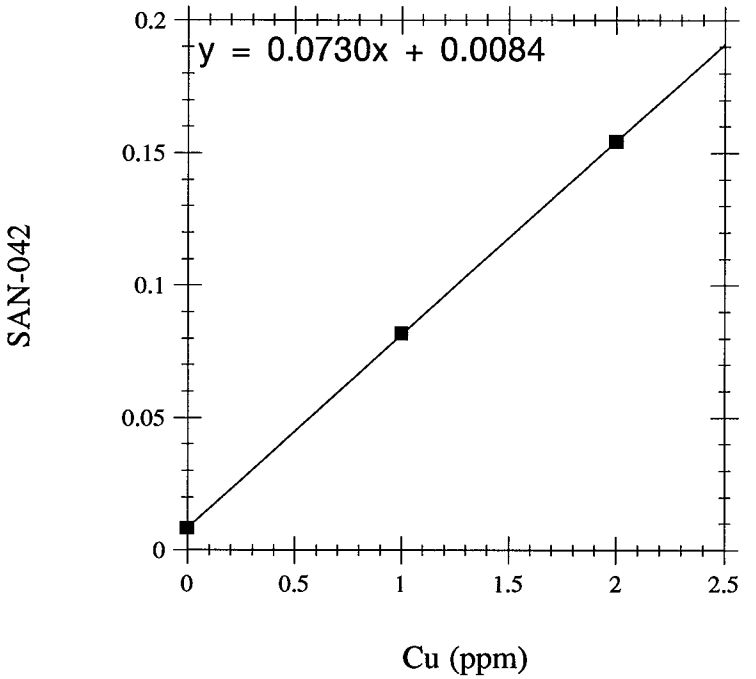

$.0376 \times 2 = .0752 \times \frac{8}{1.017} = .591 \text{ ppm}$

SAN-041 NH2OH



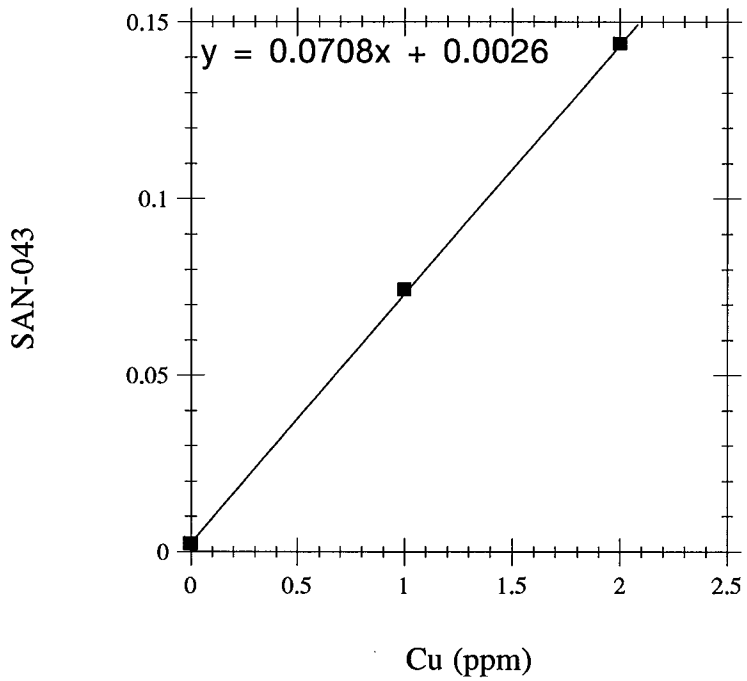

.0400 x2 = .0800 + 8/1.015 = .631 ppm

SAN-042 NH2OH



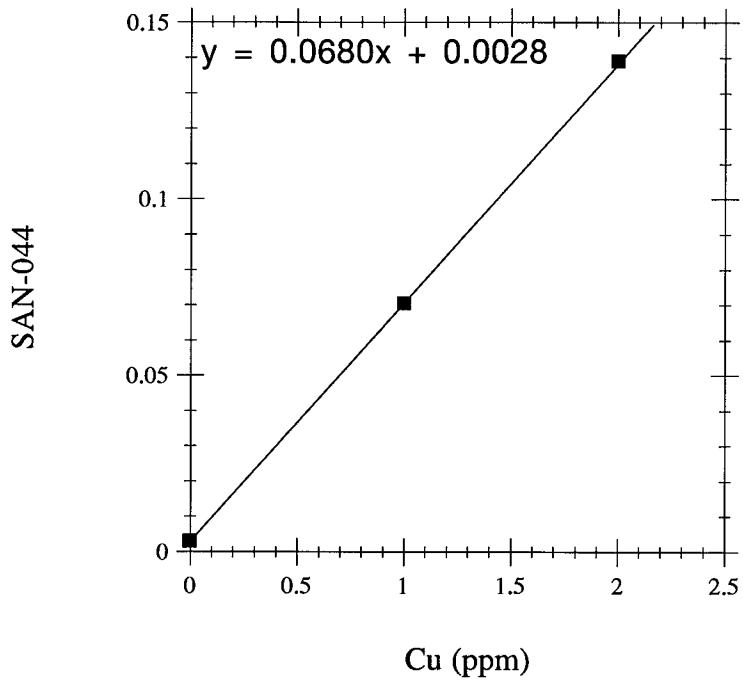

.11514 x 2 = .2302 x 8 / 1.012 = 1.8197 ppm

SAN-043 NH2OH



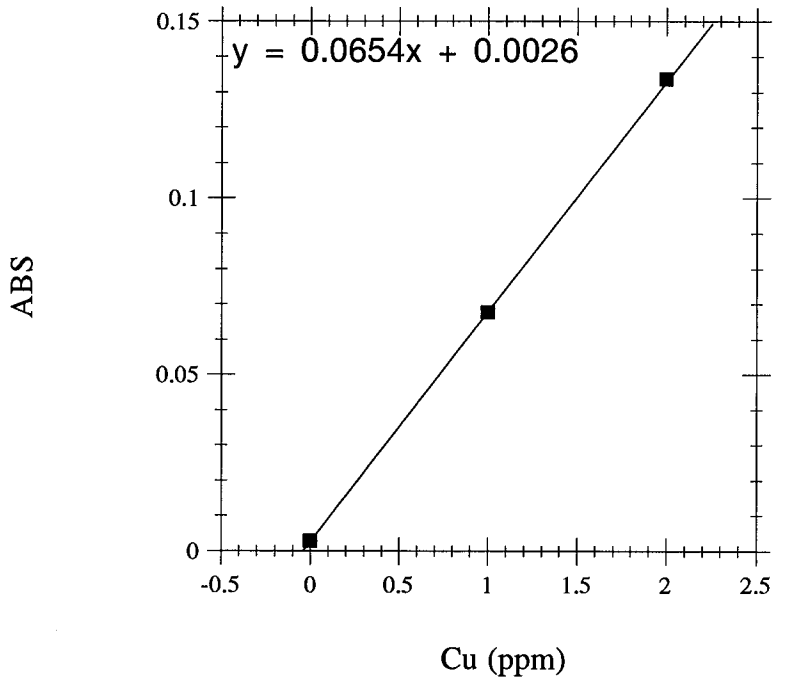

$.036742 = .0734 \times \frac{8}{1.022} = .574 ppm$

SAN-044 NH2OH




$.0412 \times 2 = .0824 \times \frac{8}{.014} = .65$ ppm

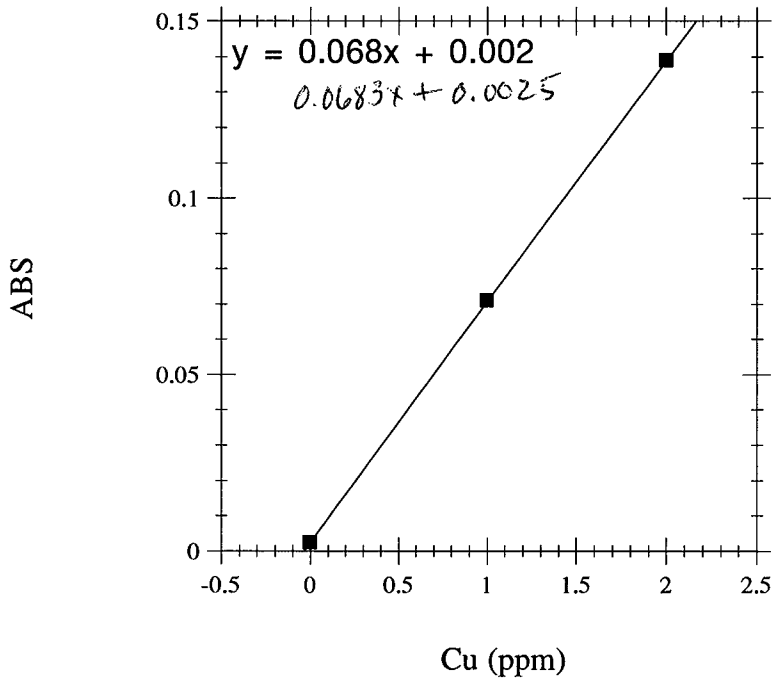
SAN-045 NH2OH




.0397 x 2 = .0794

.0794 x 8/1.017 = .625 ppm

SAN-046 NH2OH

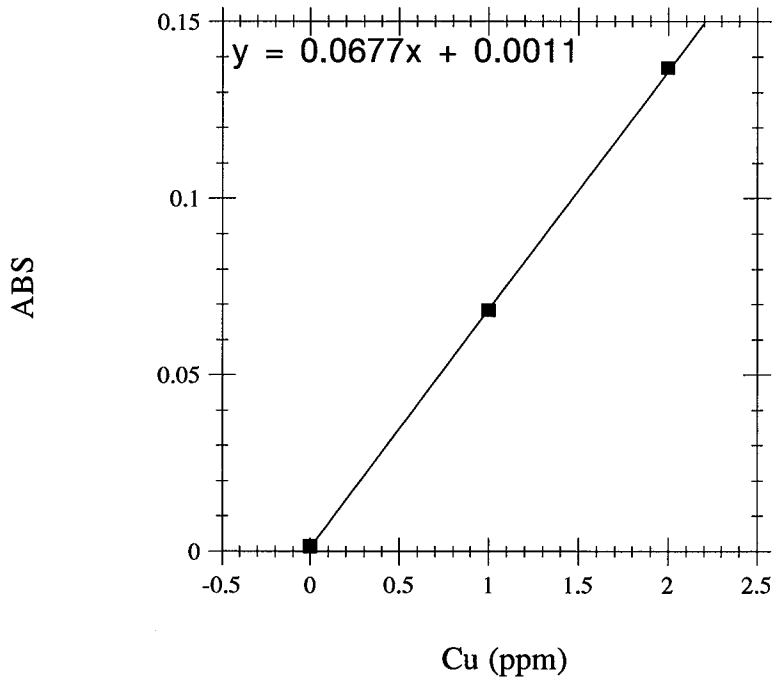



.0366

x2 = .0732

.0732 x 8/1.022 = .573 ppm

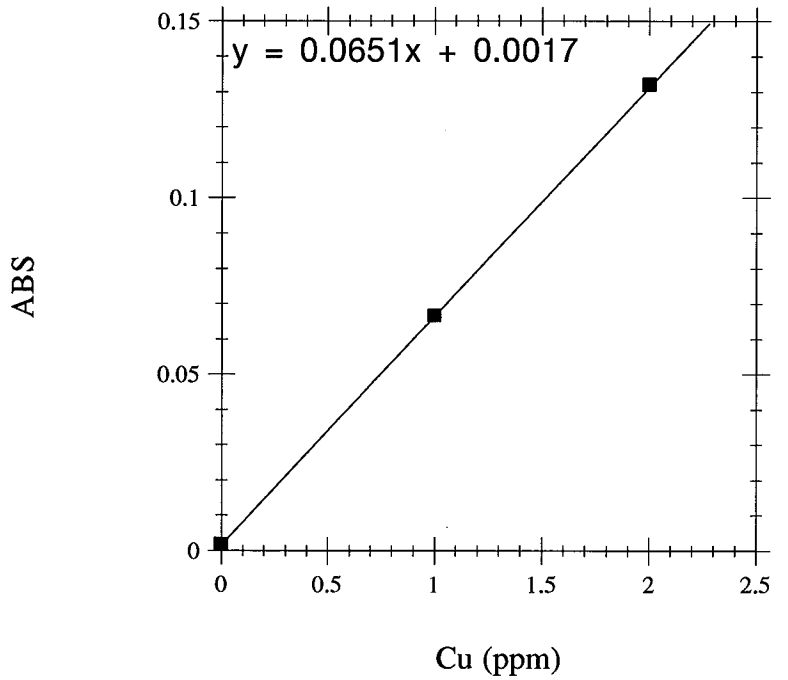
SAN-047 NH2OH




.0162 x 2 = .0324

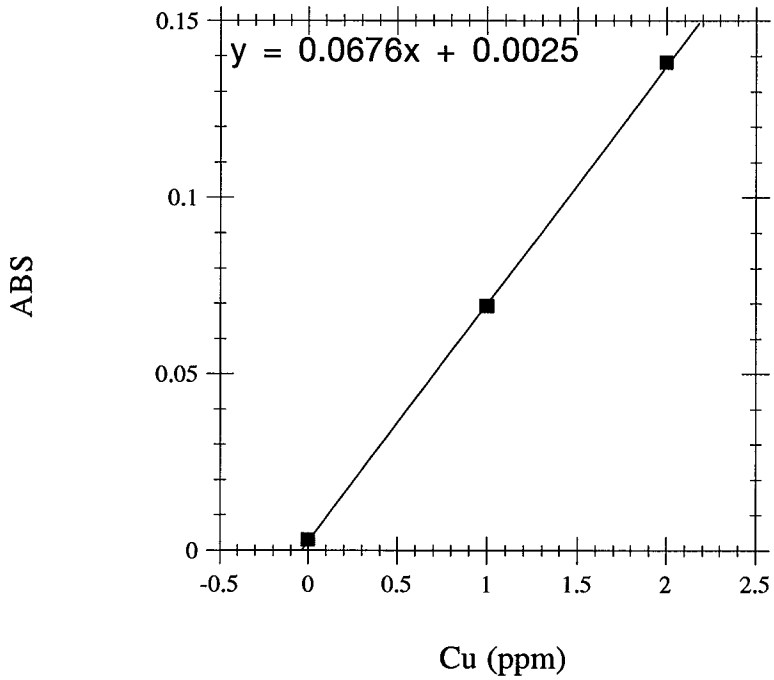
$\frac{.0324 \times 8}{1.023} = .253$ ppm

SAN-048 NH2OH



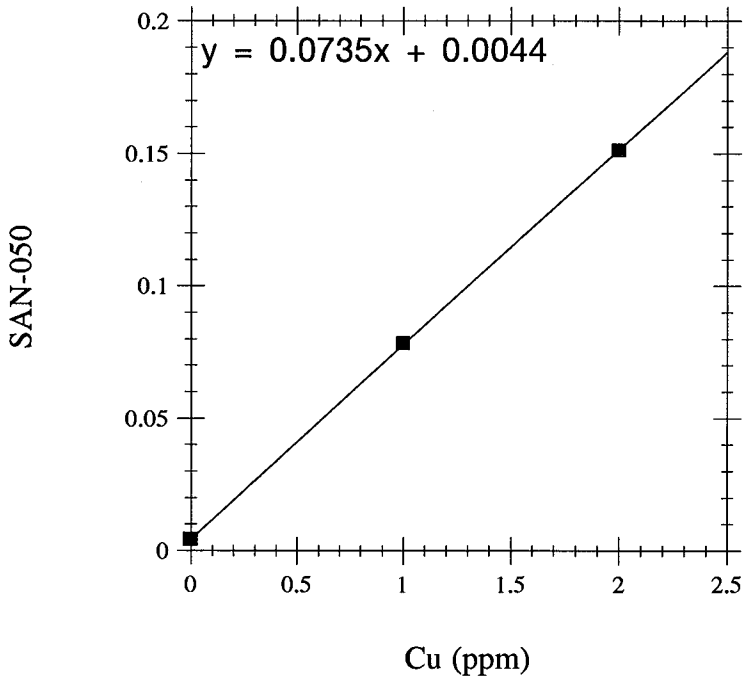

$.0261 \times 2 = .0522 + \frac{8}{1.022} = .409$ ppm

SAN-049 NH2OH



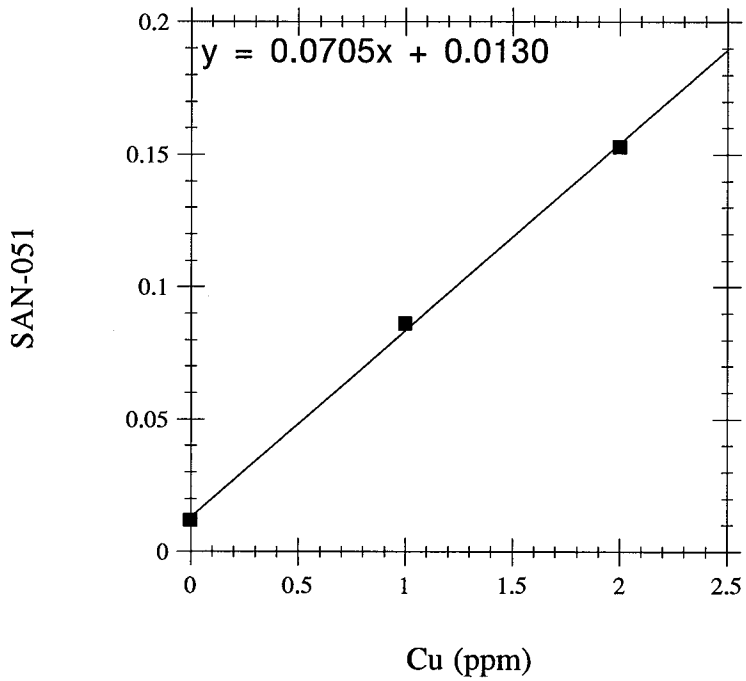

$.037 \times 2 = .074 \times \frac{8}{1.017} = .582$ ppm

SAN-050 NH2OH



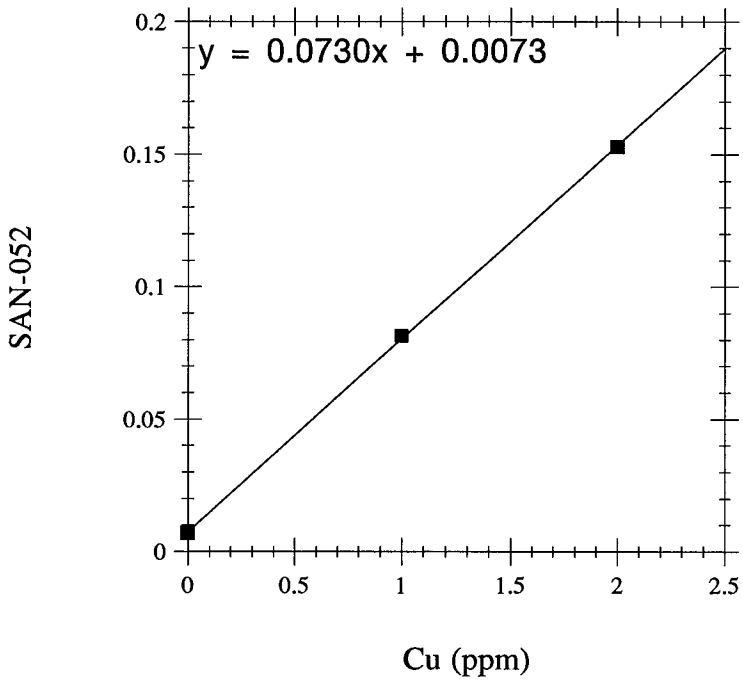

.0599x2= .1198 x 8/1.026 = .943 ppm

SAN-051 NH2OH



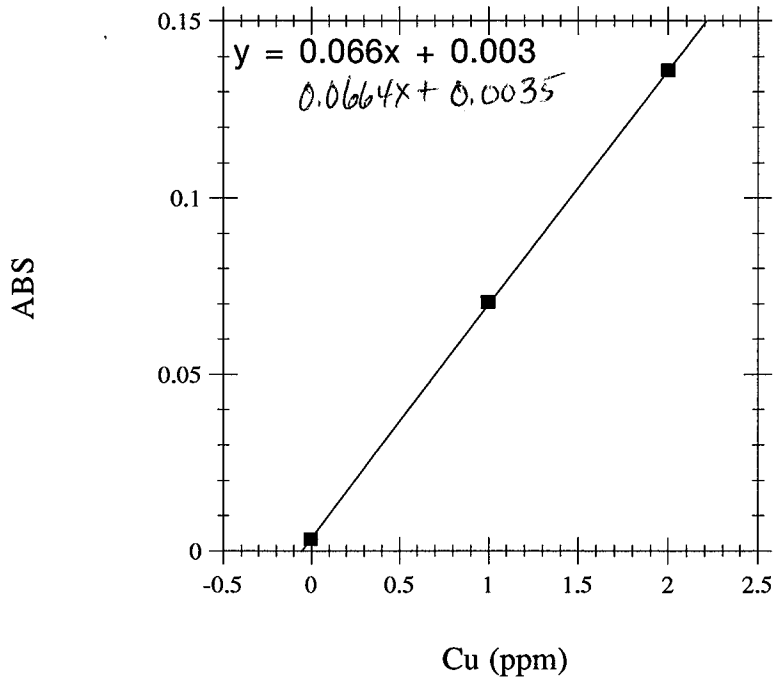

.1844 x2 = .3688 x 8/1.017 = 2.901 ppm

SAN-052 NH2OH




$.1 \times 2 = .2 + \frac{8}{1.02} = 1.568$ ppm

SAN-053 NH2OH



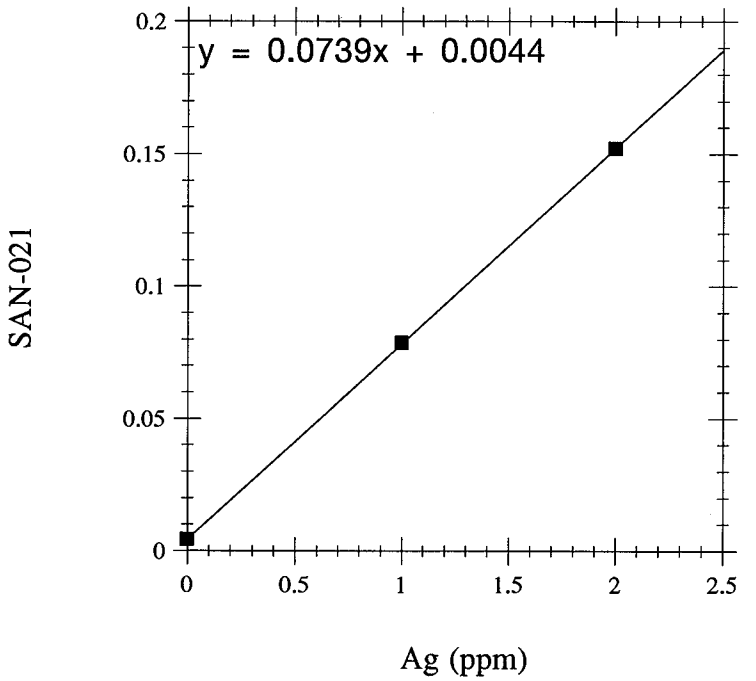

.0527

x2 = .1054

$.1054 \times \frac{8}{1.008} = .836$ ppm

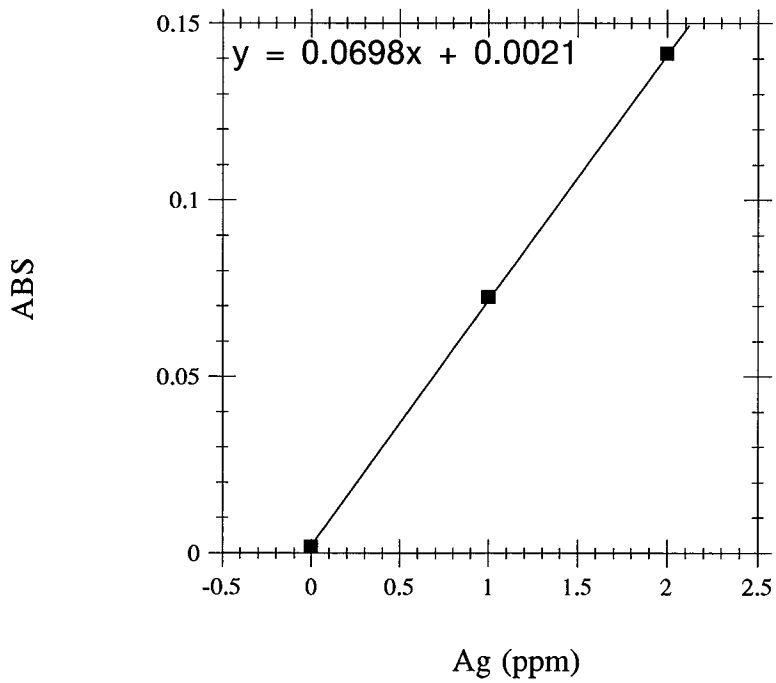
Ag data

SAN-021 MgCl2




.0595 x 2 = .119 x 8/1.0 = .937 ppm

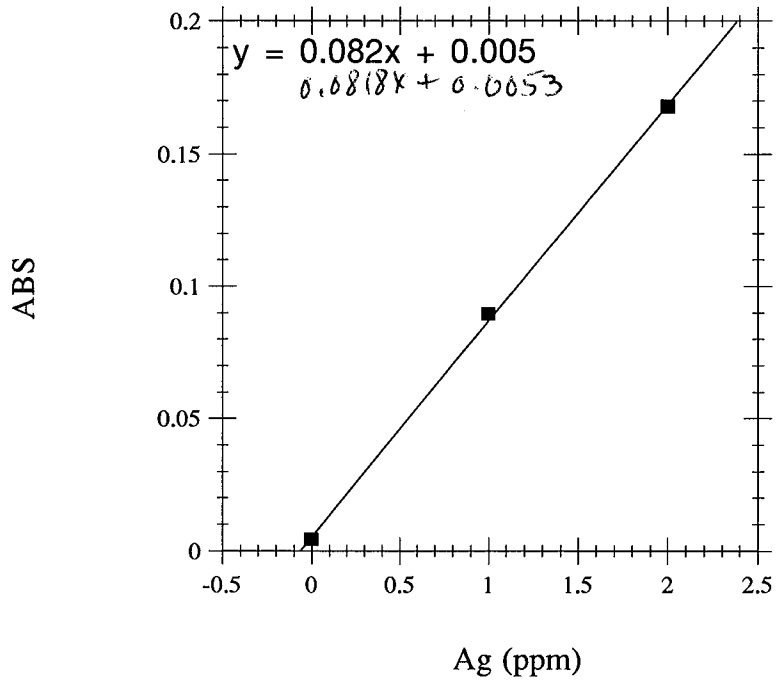
SAN-022 MgCl2




.0300 x 2 = .0600

.0600 x 8/1.022 = .4697 ppm

SAN-023 MgCl2

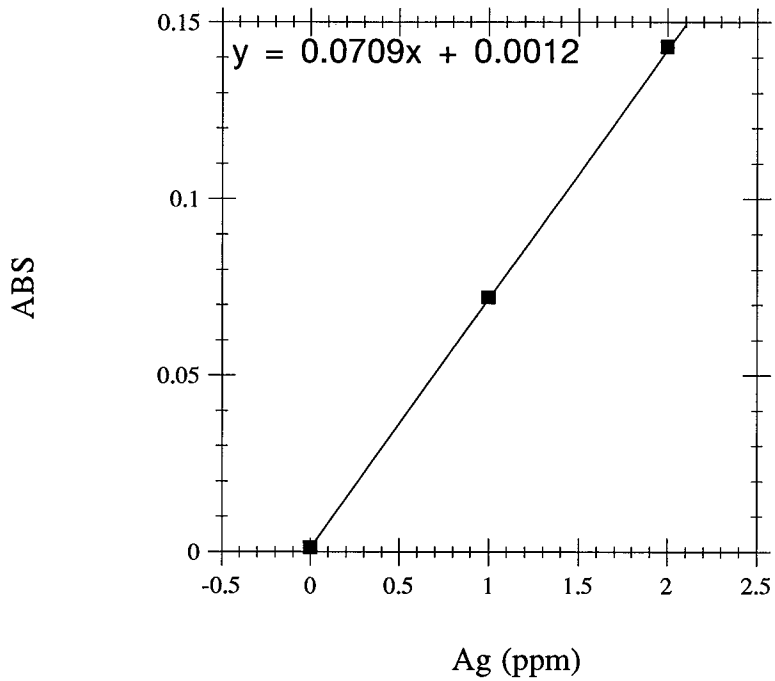



.0648

x2 = .1296

$.1296 \times \frac{8}{1.022} = \underline{1.014 \text{ ppm}}$

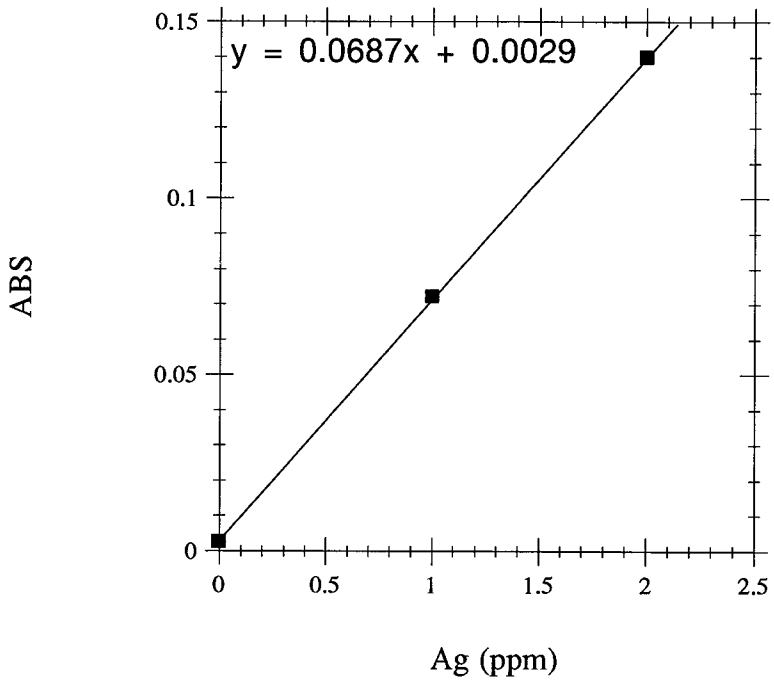
SAN-024 MgCl2




.0169 x 2 = .0338

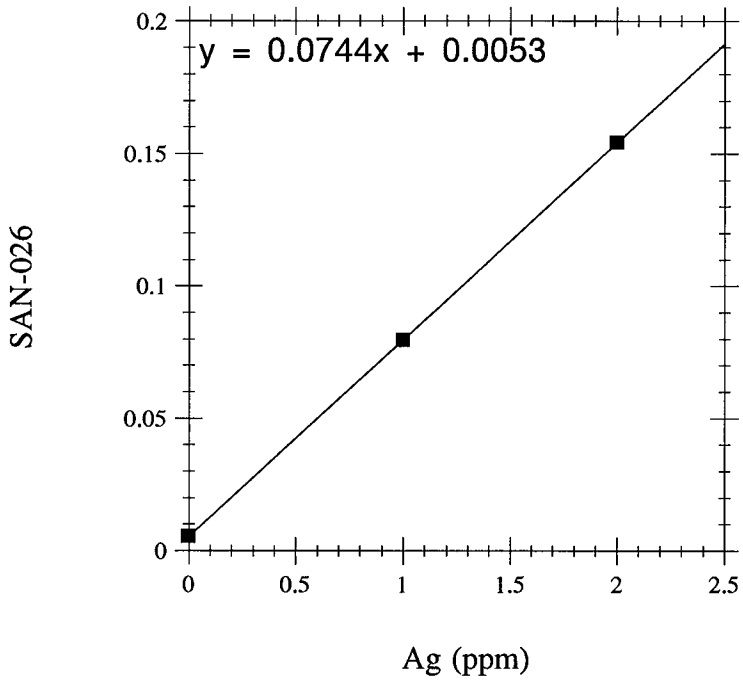
.0338 x 8/1.018 = .266 ppm

SAN-025 MgCl2



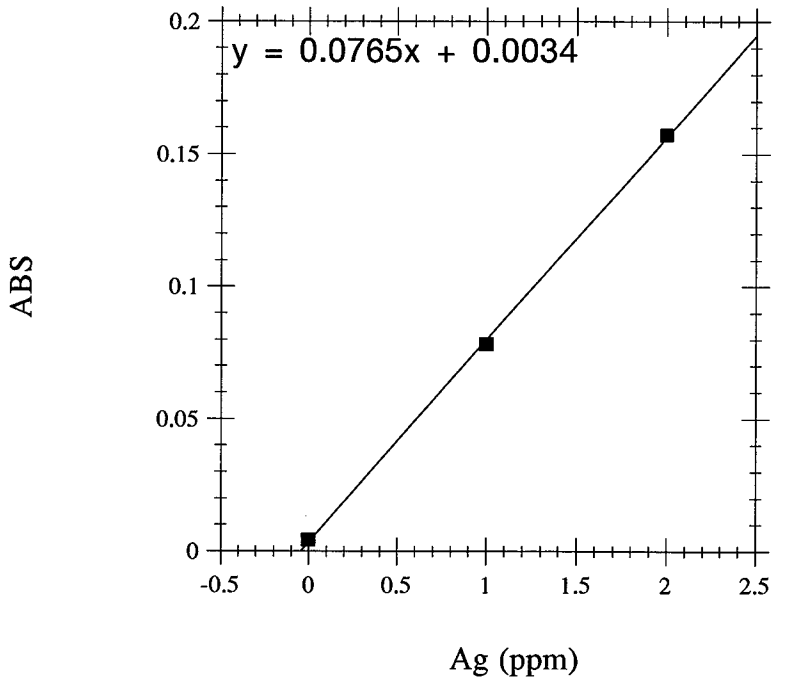

$.0422 \times 2 = .0844 \times \frac{8}{1.025} = .659$ ppm

SAN-026 MgCl2



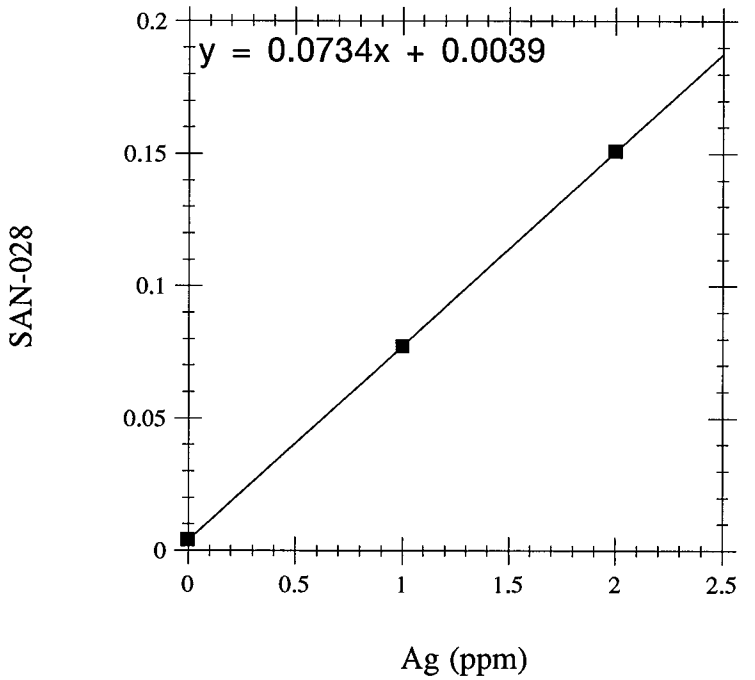

.0712 x 2 = .1424 x 8/1.021 = 1.116 ppm

SAN-027 MgCl2



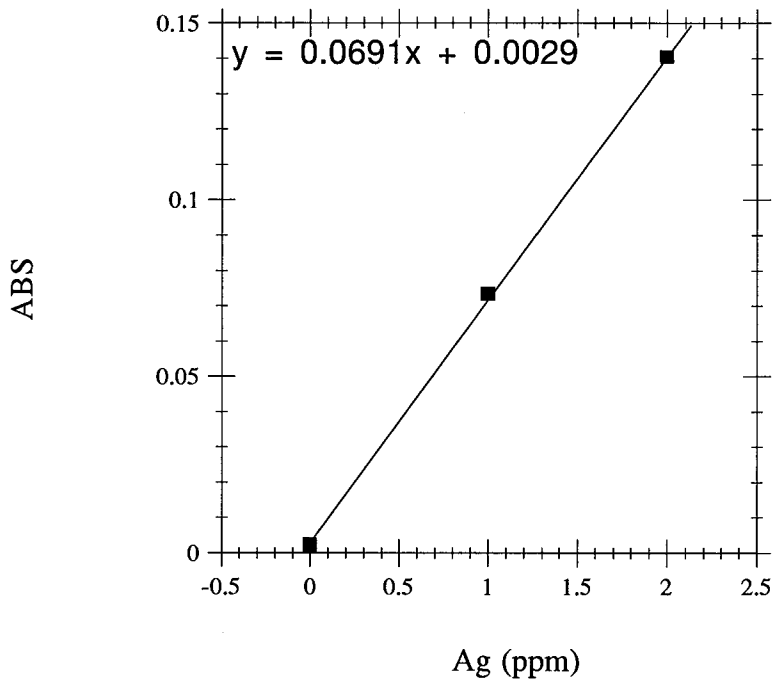

.0444 x 2 = .0888 + 8/1.013 = .701 ppm

SAN-028 MgCl2




.0531x2 = .1062 x 8 / .023 = .830ppm

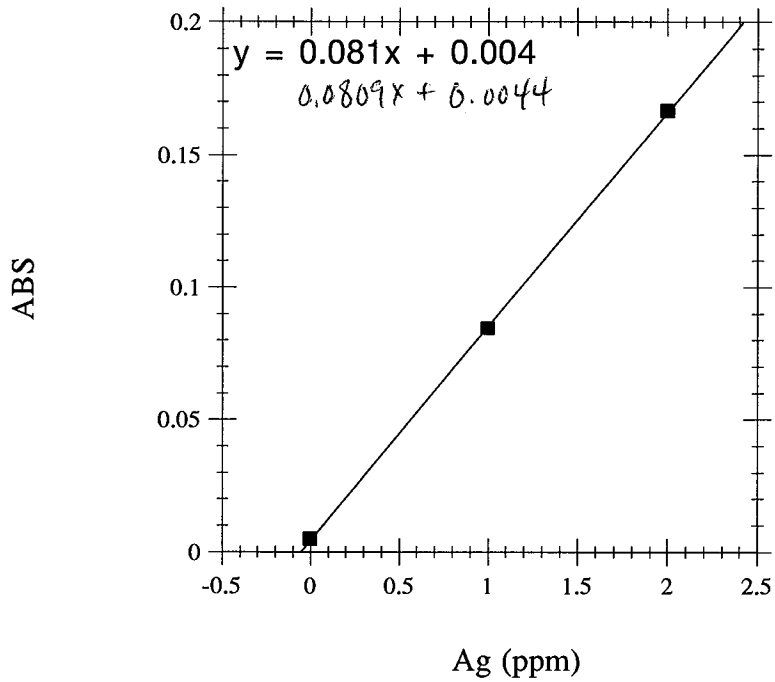
SAN-029 MgCl2




.0420 x 2 = .084

.084 x 8 / 1.020 = .659ppm

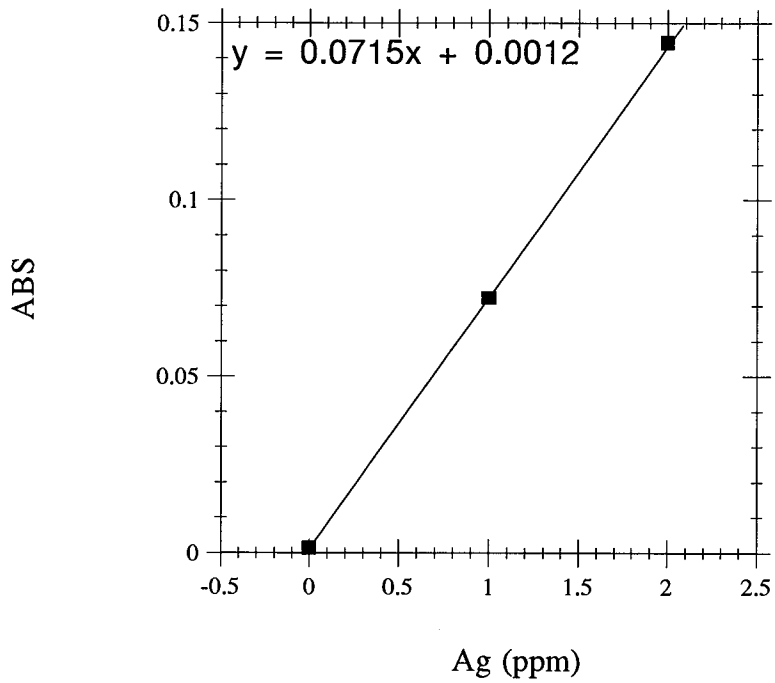
SAN-030 MgCl2




.0544 x 2 = .1088

$.1088 \times \frac{8}{1.022} = .852$ ppm

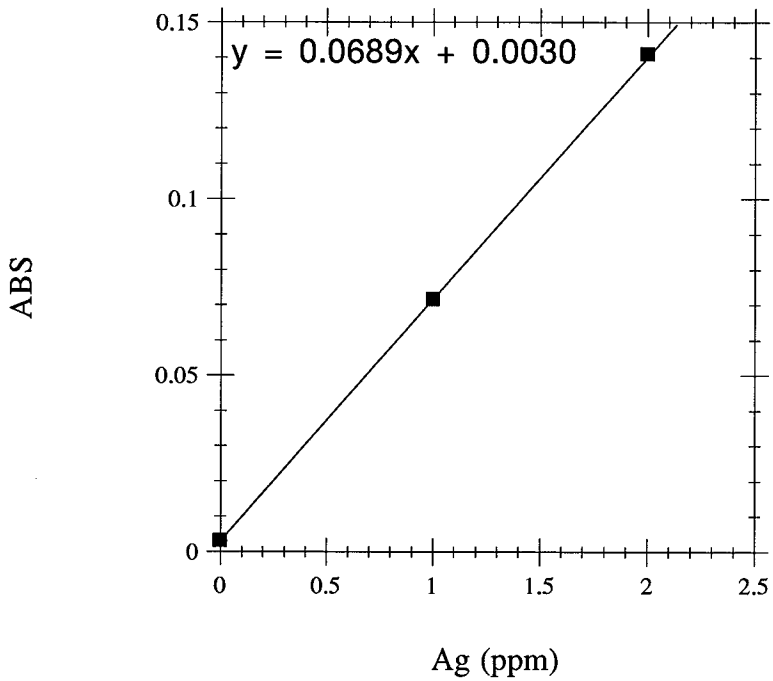
SAN-031 MgCl2




.0168 x 2 = .0336

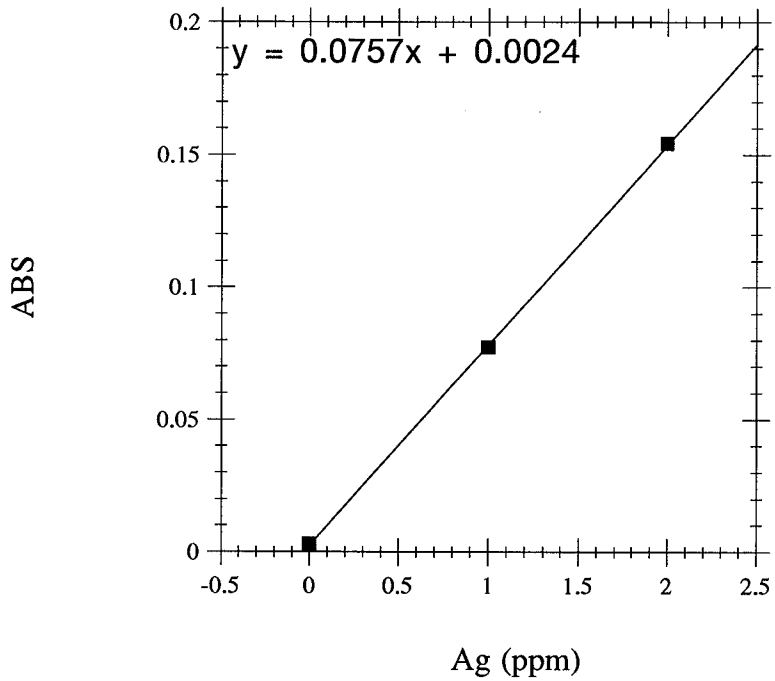
$\frac{.0336 \times 8}{1.026}$ = .262 ppm

SAN-032 MgCl2



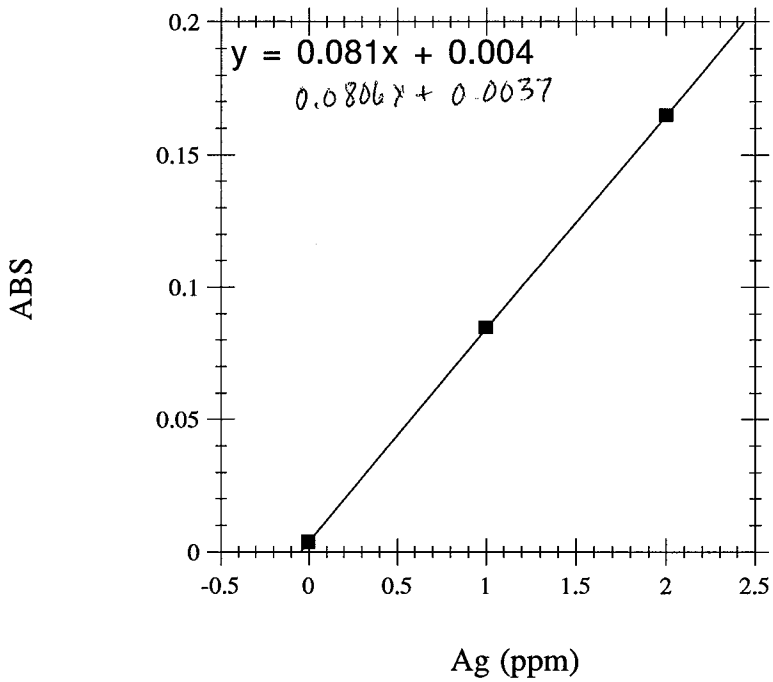

$.0435 \times 2 = .087 \times \frac{8}{1.017} = .684$ ppm

SAN-033 MgCl2




.0317 x 2 = .0634 x 8/1.012 = .501 ppm

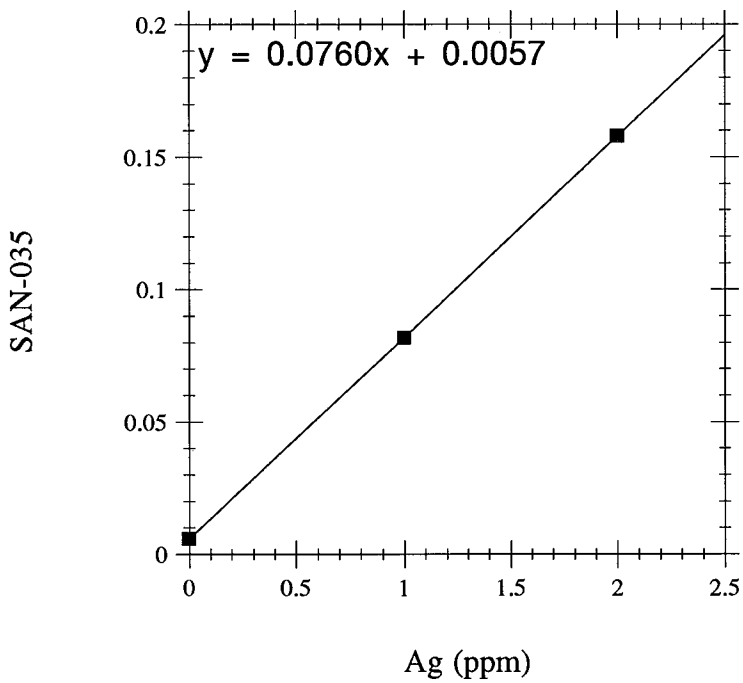
SAN-034 MgCl2




.0459 x 2 = .0918

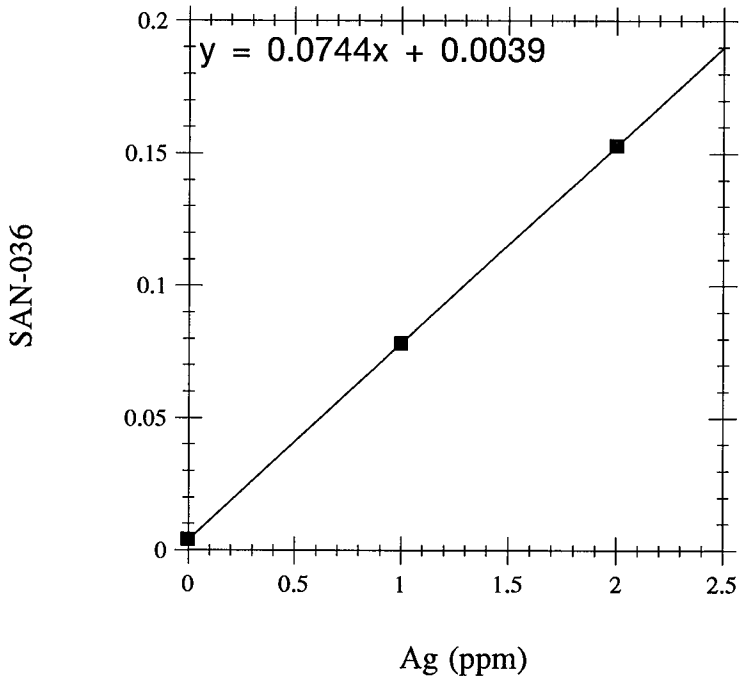
$\frac{.0918 \times 8}{1.009} = .728$ ppm

SAN-035 MgCl2



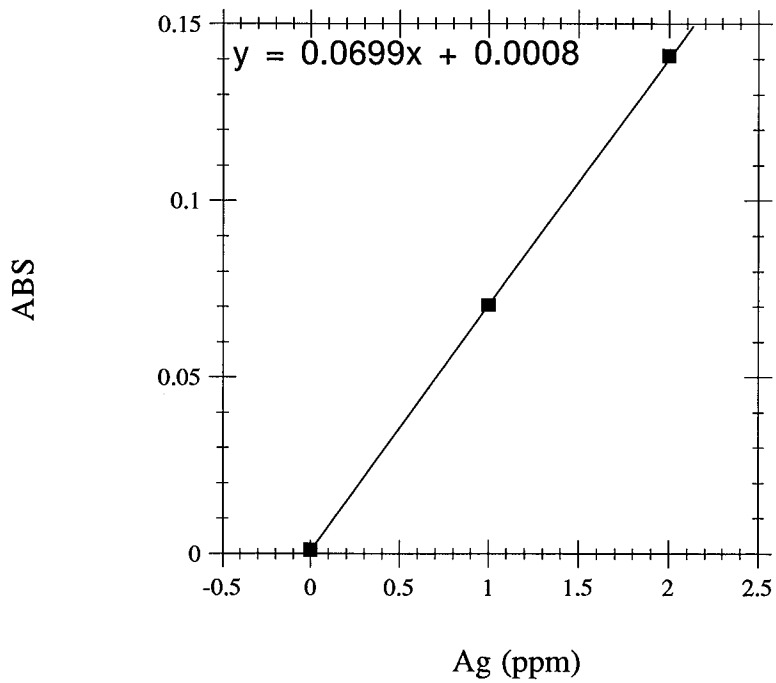

.075 x 2 = .150 x 8/1.02 = 1.176 ppm

SAN-036 MgCl2




.0524 x 2 = .1048 x 8/1.014 = .827 ppm

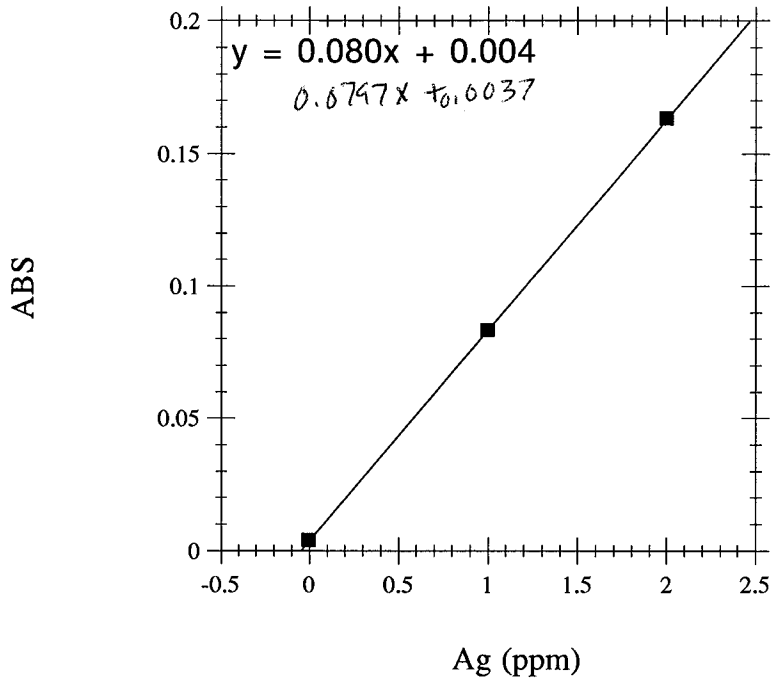
SAN-037 MgCl2




.0114 x 2 = .0228

.0228 x 8 / 1.021 = .179 ppm

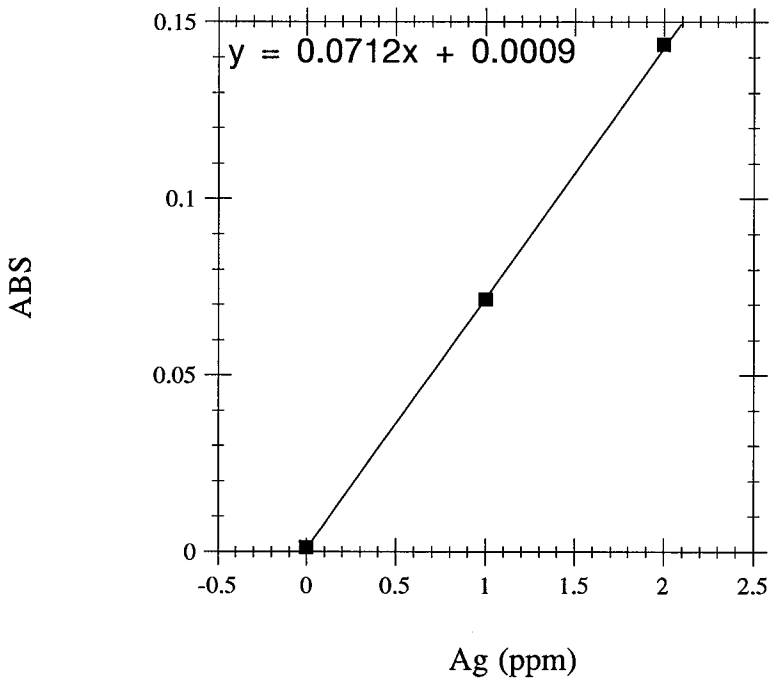
SAN-038 MgCl2




.0444 x2 = .0928

.0928 x 8/1.024 = .725 ppm

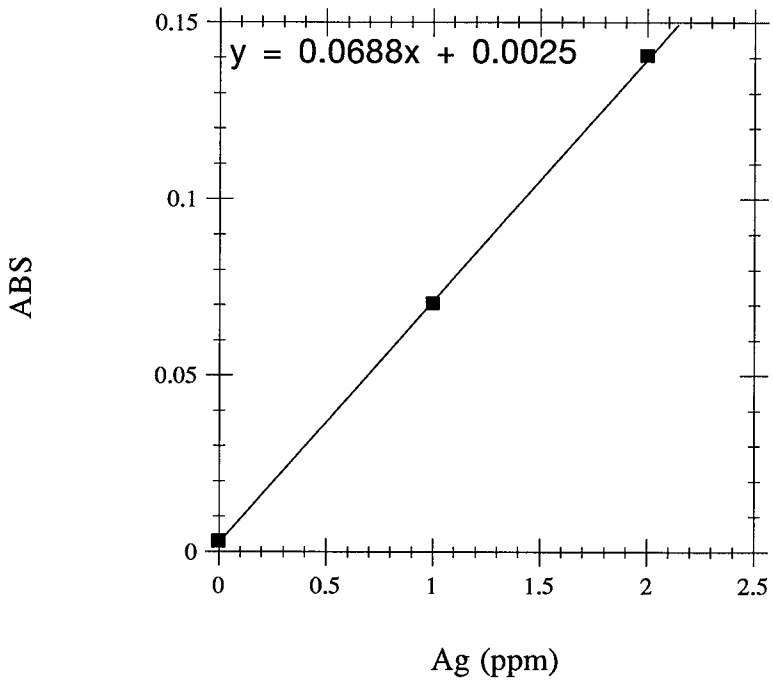
SAN-039 MgCl2




.0126 x 2 = .0252

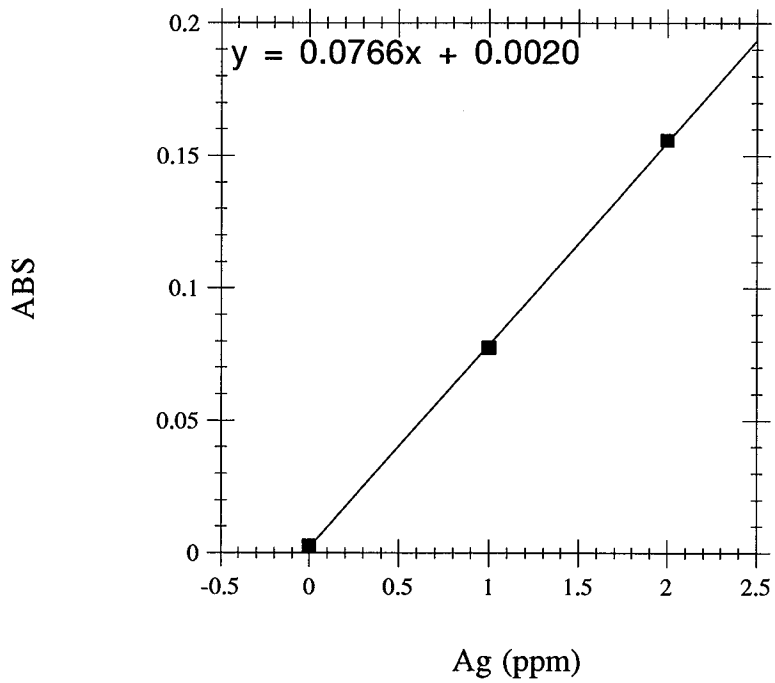
$\frac{.0252 + 8}{1.018}$ = .198 ppm

SAN-040 MgCl2



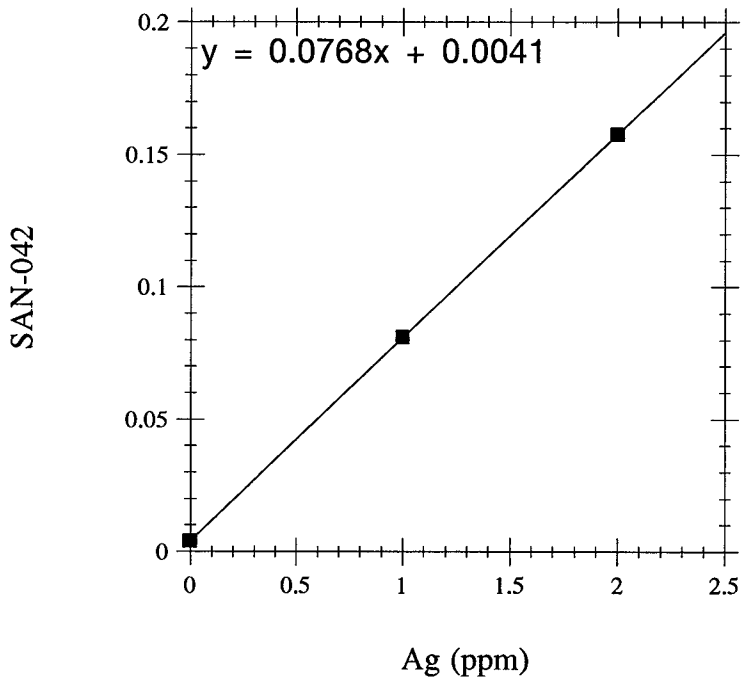

$.0363 \times 2 = .0726 \times \frac{8}{1.017} = .571$ ppm

SAN-041 MgCl2



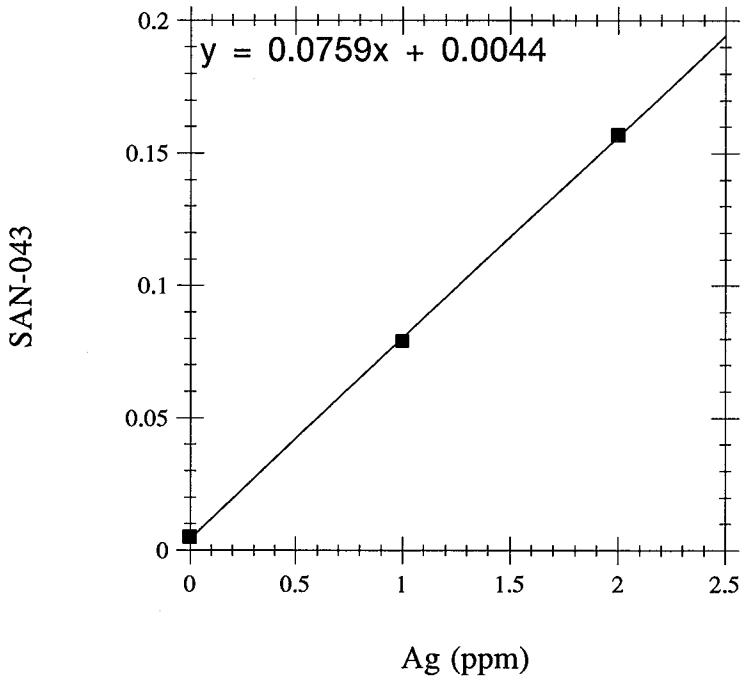

.0261 x 2 = .0522 x 8/1.015 = .411 ppm

SAN-042 MgCl2



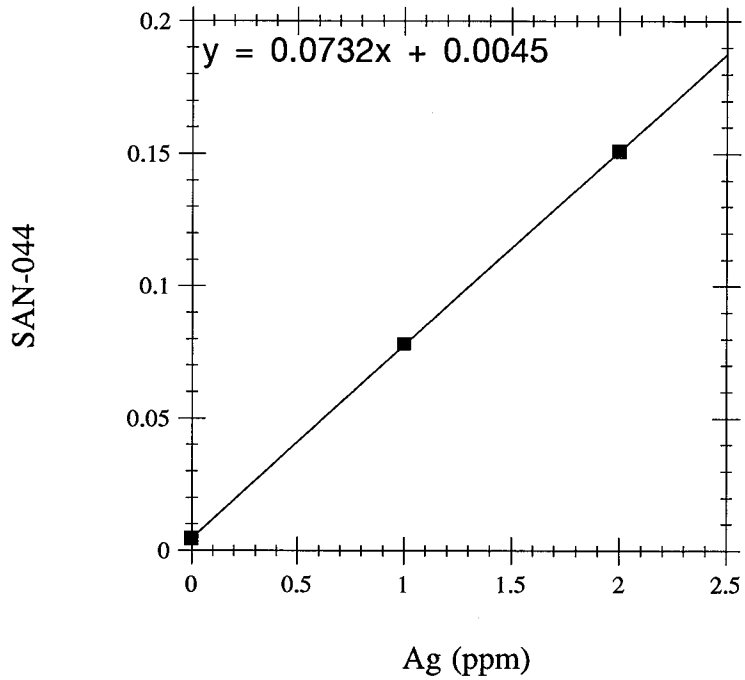

$.0534 \times 2 = .1068 \times \frac{8}{1.012} = .844$ ppm

SAN-043 MgCl2



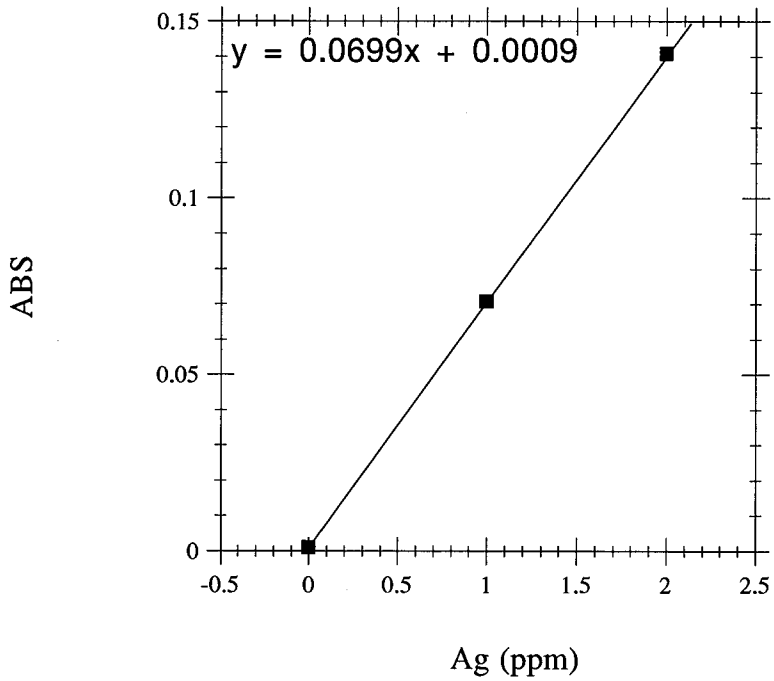

.05797 x 2 = .11594 x 8/1.022 = .907 ppm

SAN-044 MgCl2




.0615 x 2 = .123 x 8 / 1.014 = .970 ppm

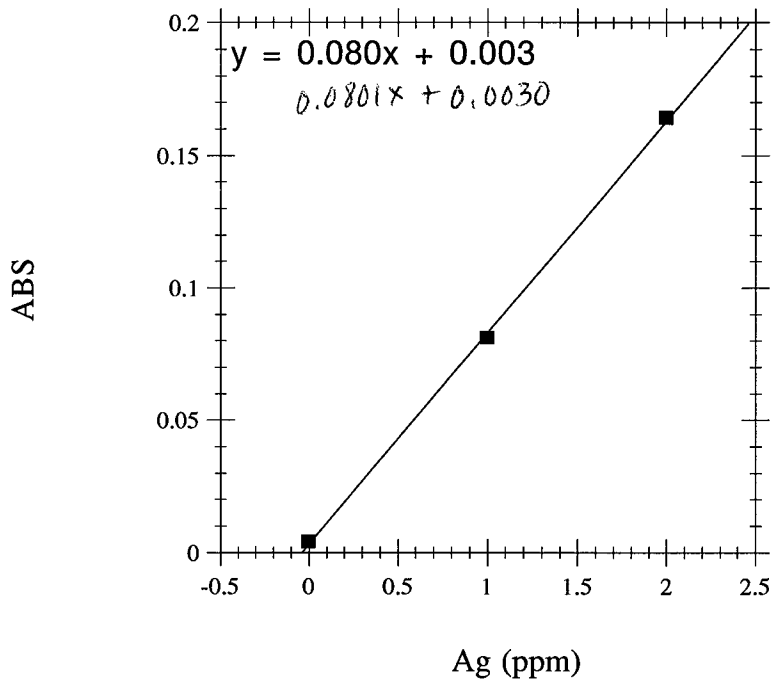
SAN-045 MgCl2




.0129 x 2 = .0258

.0258 x 8/1.017 = .203 ppm

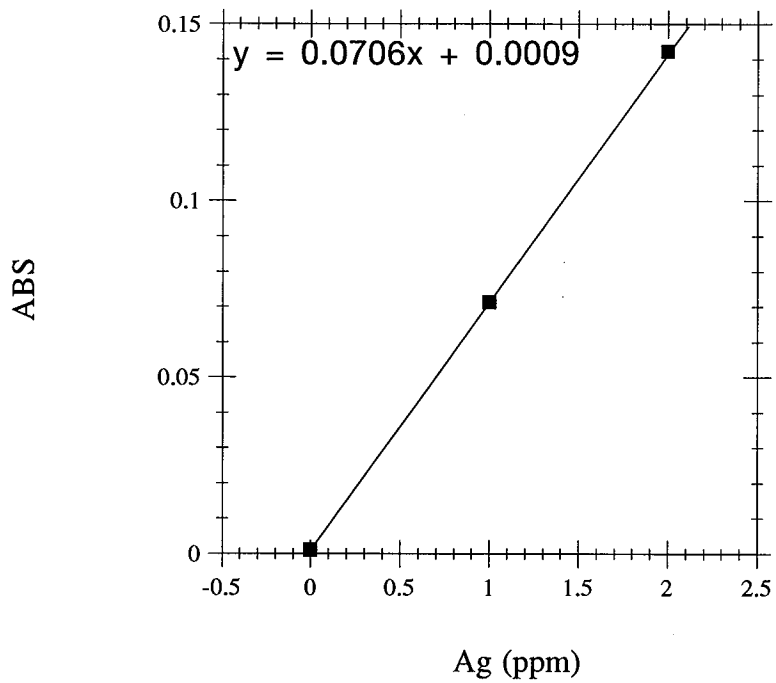
SAN-046 MgCl2




.0374 x 2 = .0748

$\frac{.0748 \times 8}{1.022}$ = .585 ppm

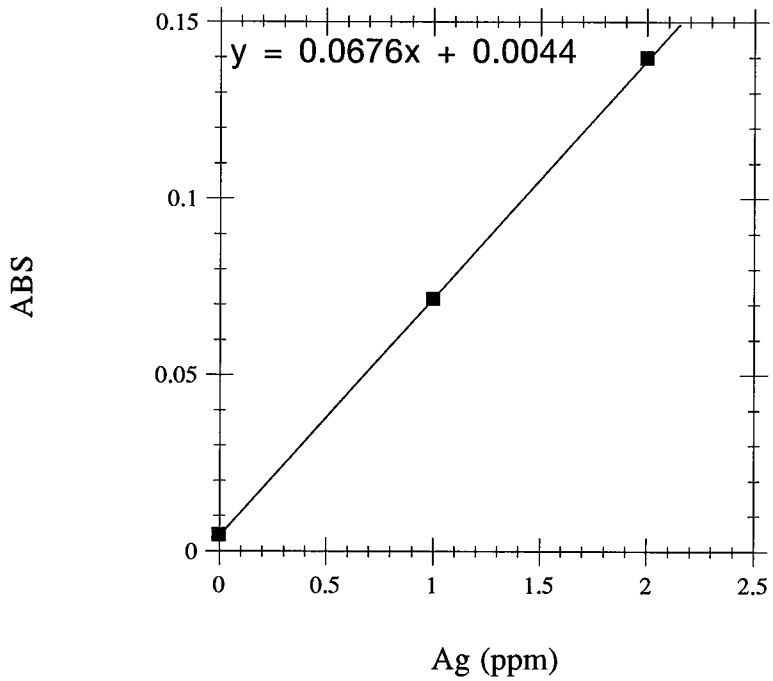
SAN-047 MgCl2




.0127 × 2 = .0254

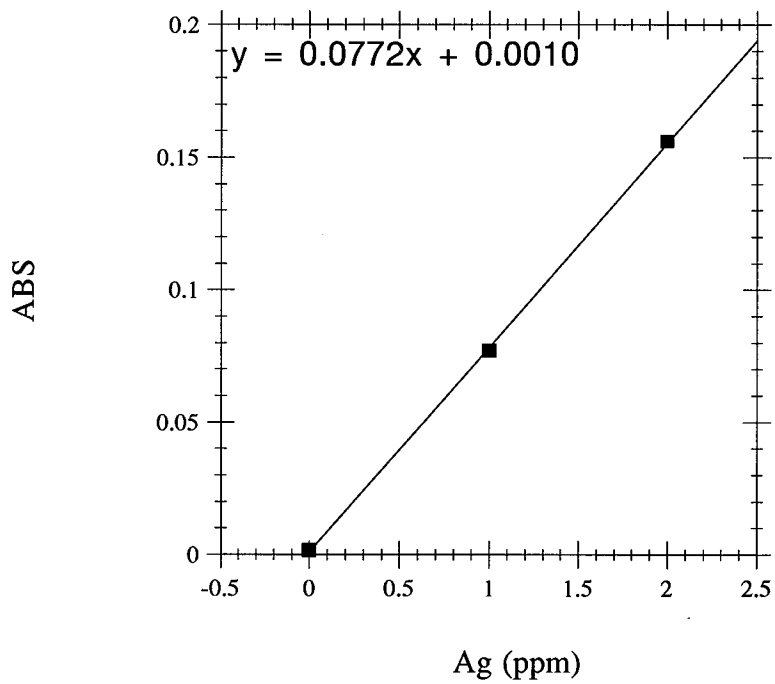
.0254 × 8/1.023 = .199 ppm

SAN-048 MgCl2



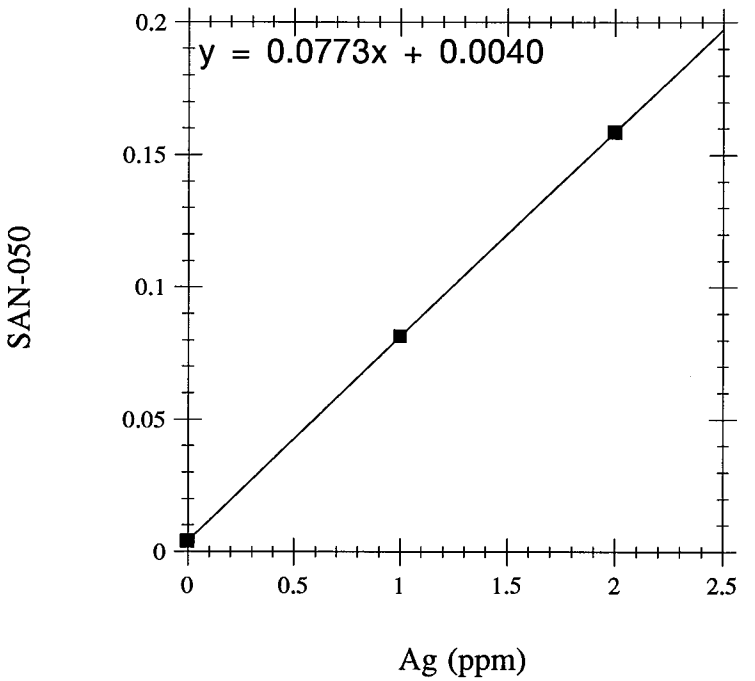

$.0651 \times 2 = .1302 \times \frac{8}{1.022} = 1.019$ ppm

SAN-049 MgCl2



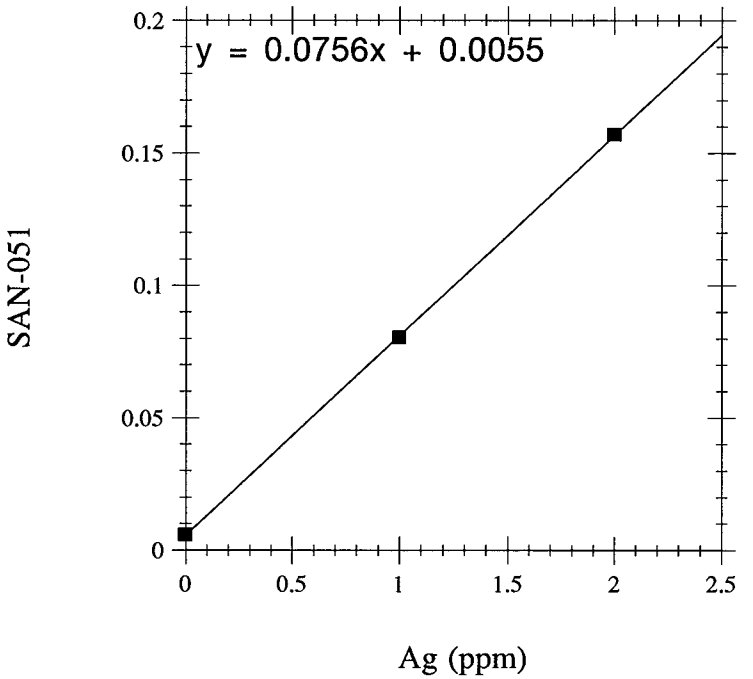

.01295 x2 = .0259 x 8/1.017 = .204ppm

SAN-050 MgCl2



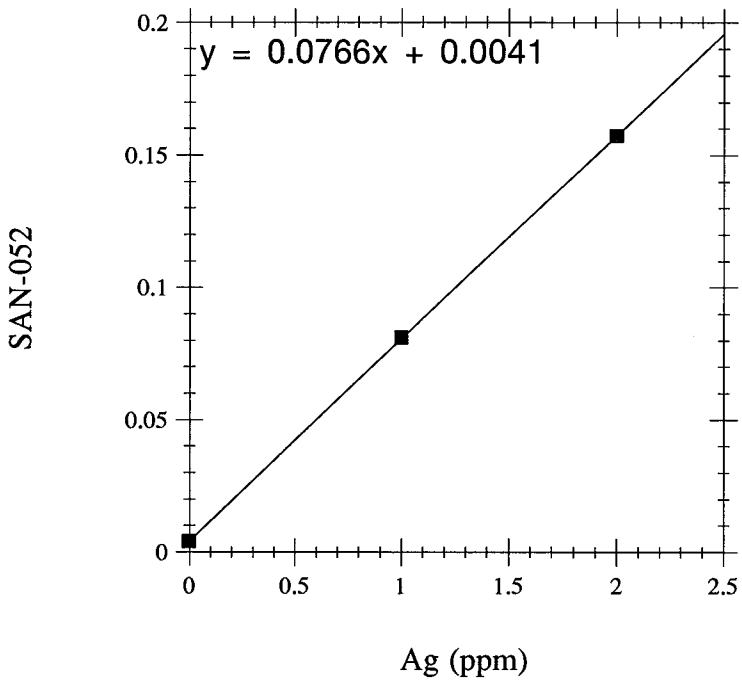

$.0517 \times 2 = .1034 \times \frac{8}{1.016} = .814$ ppm

SAN-051 MgCl2



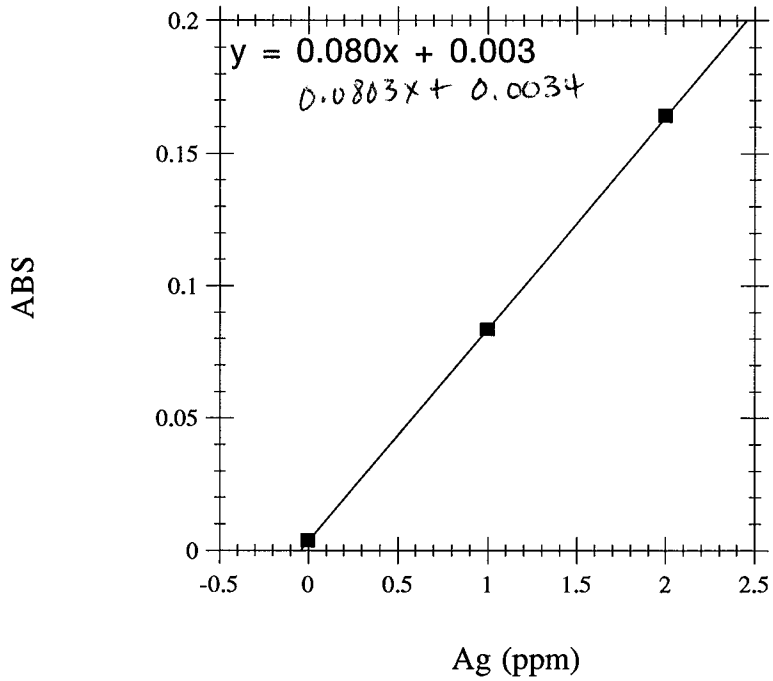

.0727 x 2 = .1454 x 8 / 1.017 = 1.144 ppm

SAN-052 MgCl2




$.0535 \times 2 = .107 \times \frac{8}{1.02} = .839$ ppm

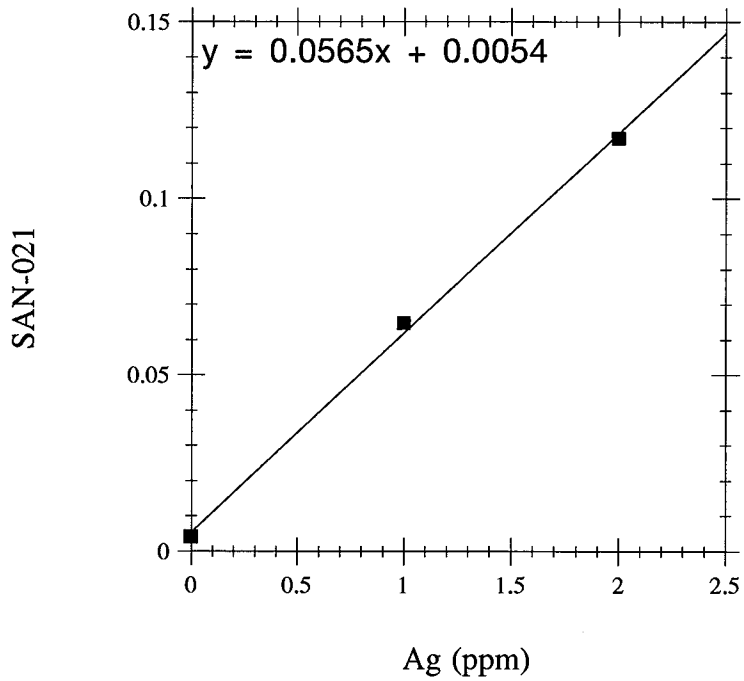
SAN-053 MgCl2




.0423 × 2 = .0846

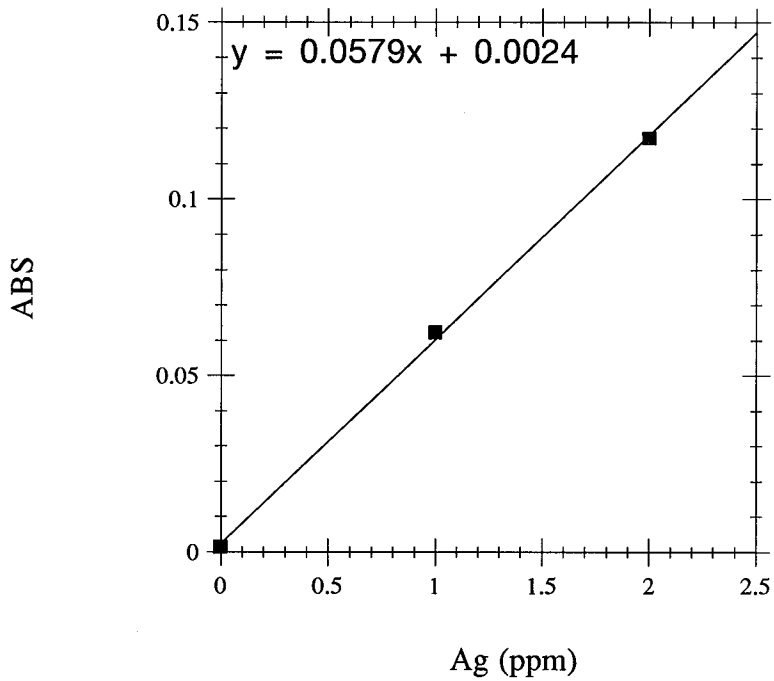
$.0846 \times \frac{8}{1.008} = .671$ ppm

SAN-021 NaOAc




.0956 x 2 = .1912 x 8/1.016 = 1.505 ppm

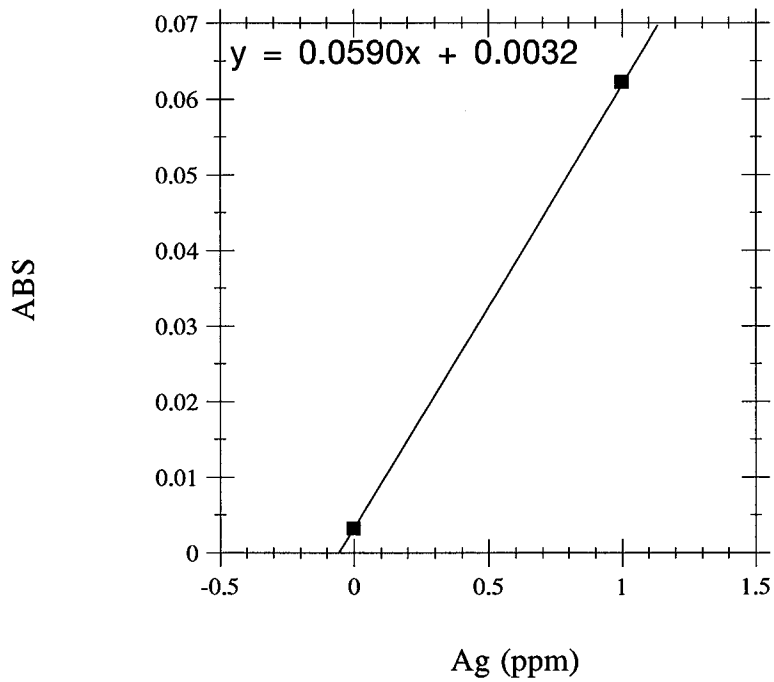
SAN-022 NaOAc




.0415 x 2 = .0830

$.0830 \times \frac{8}{1.022} = .650$ ppm

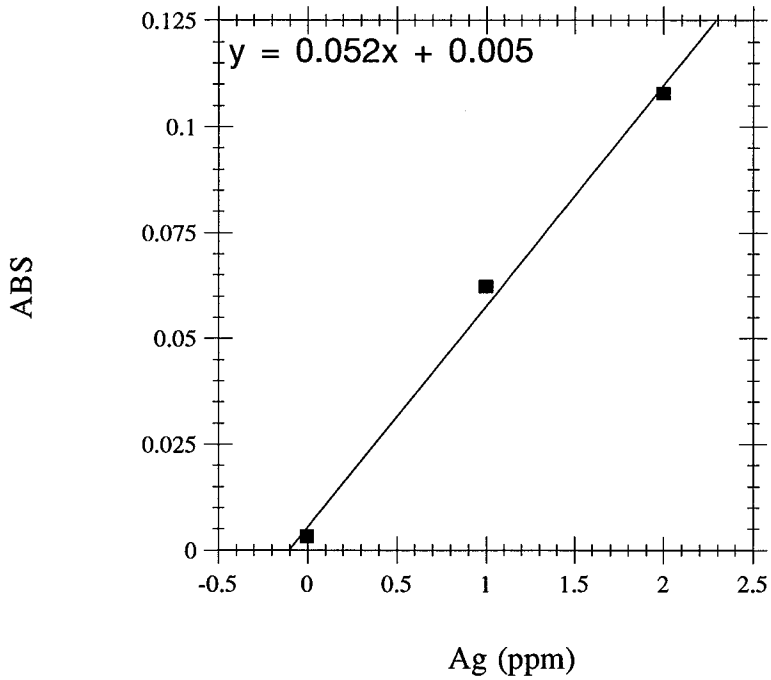
SAN-023 NaOAc



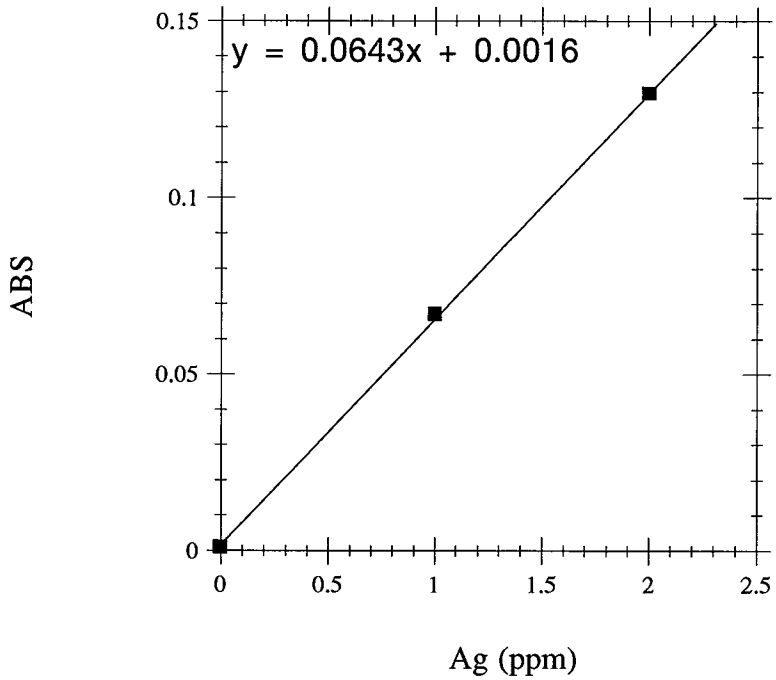

.0542 x 2 = .1084

$.1084 \times \frac{8}{1.022} = .848$ ppm

SAN-023 NaOAc



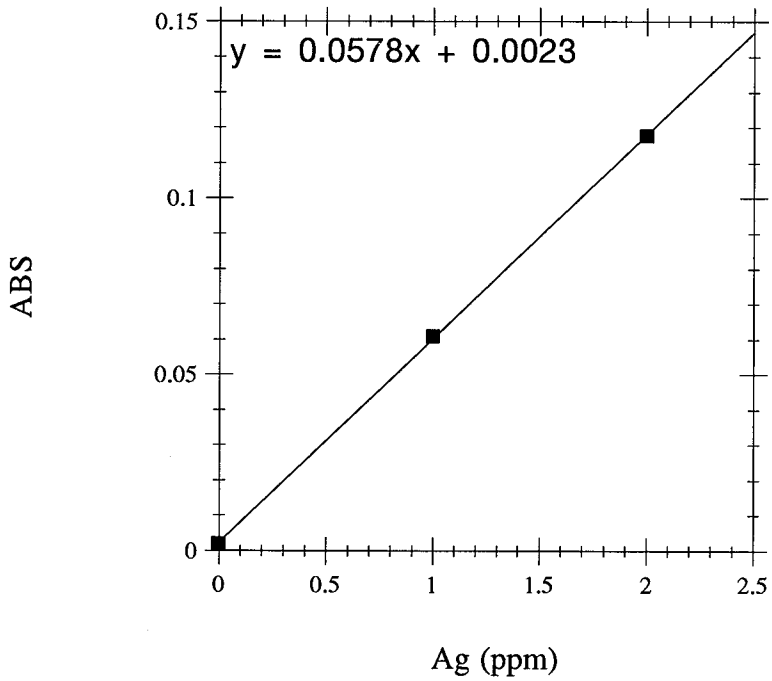
SAN-024 NaOAc




.0249 x 2 = .0498

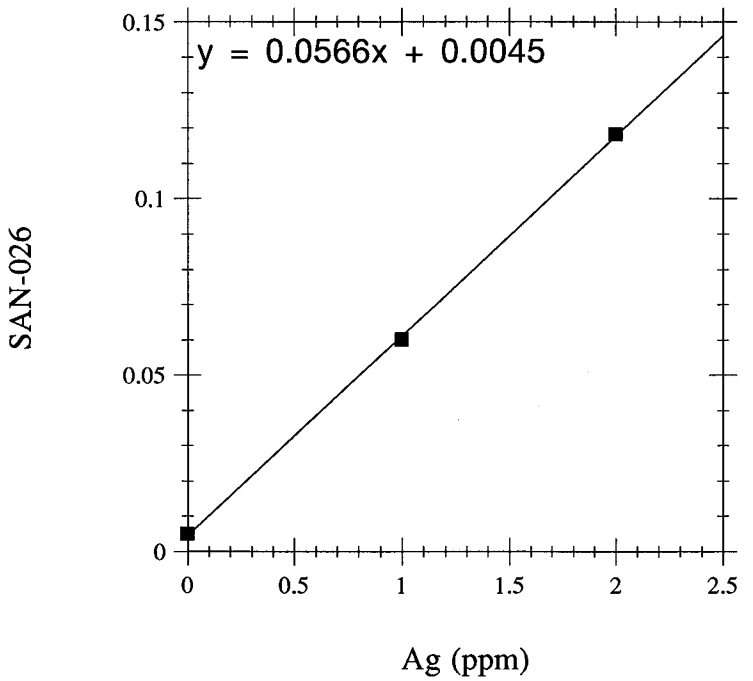
.0498 x 8 / 1.018 = .391 ppM

SAN-025 NaOAc



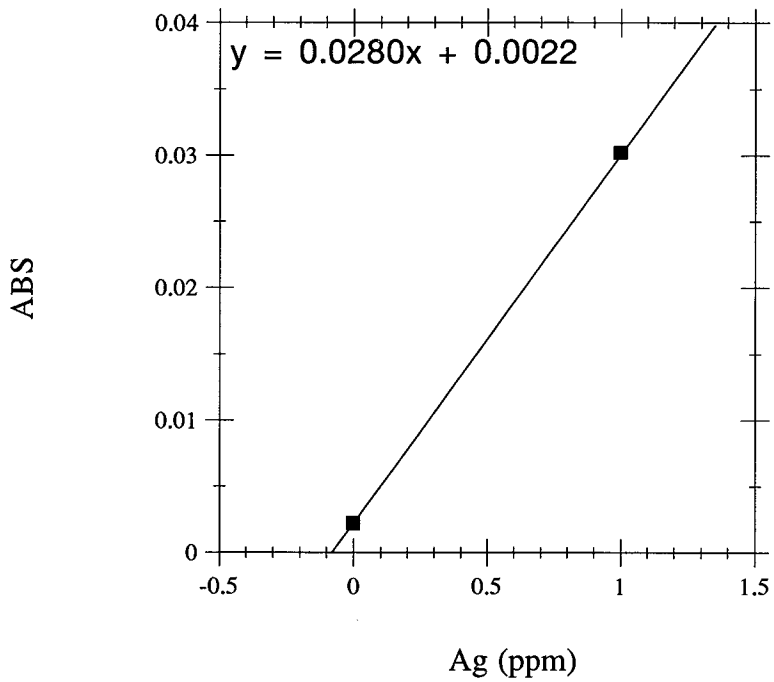

$.0398 \times 2 = .0796 \times \frac{8}{1.025} = .621$ ppm

SAN-026 NaOAc



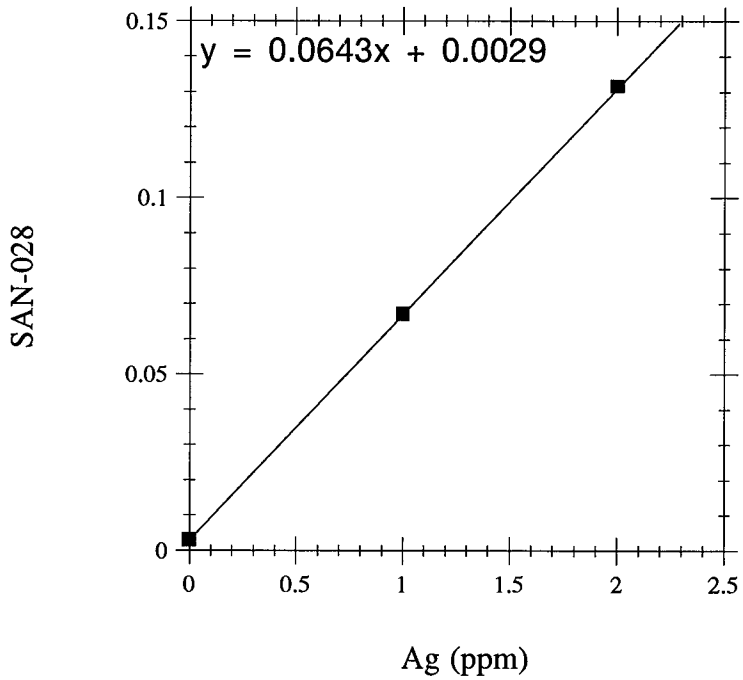

$.0795 \times 2 = .159 \times \frac{8}{1.021} = 1.246$ ppm

SAN-027 NaOAc



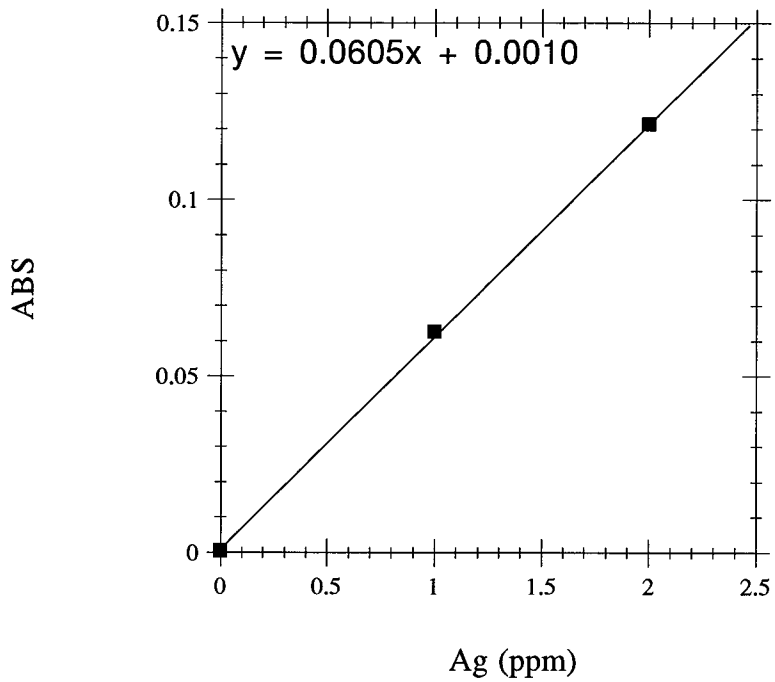

$.0786 \times 2 = .1572 \times \frac{8}{1.013} = 1.24$ ppm

SAN-028 NaOAc




.0451 x 2 = .0902 + 8 / 1.023 = .705 ppm

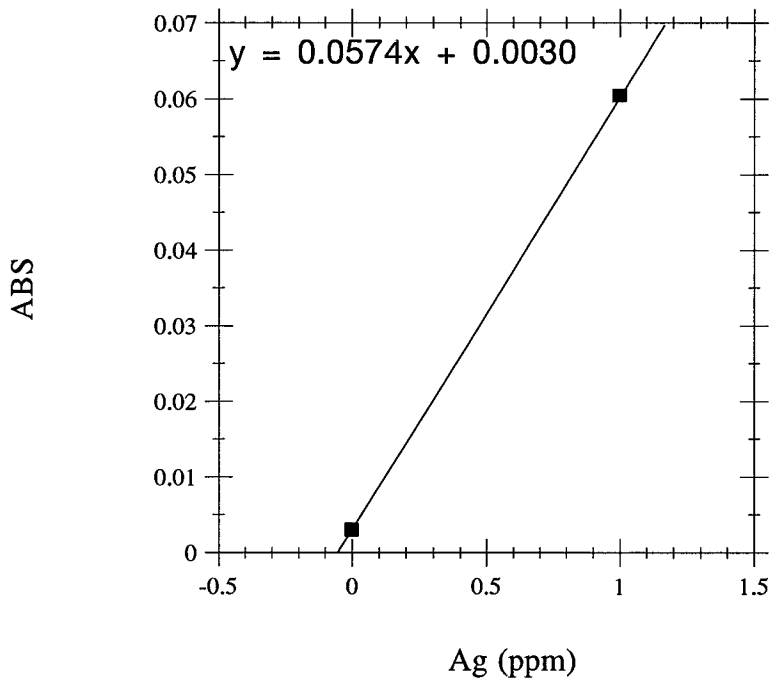
SAN-029 NaOAc




.0165 x 2 = .033

.033 x 8/1.020 = ~~.258~~ .259 ppm

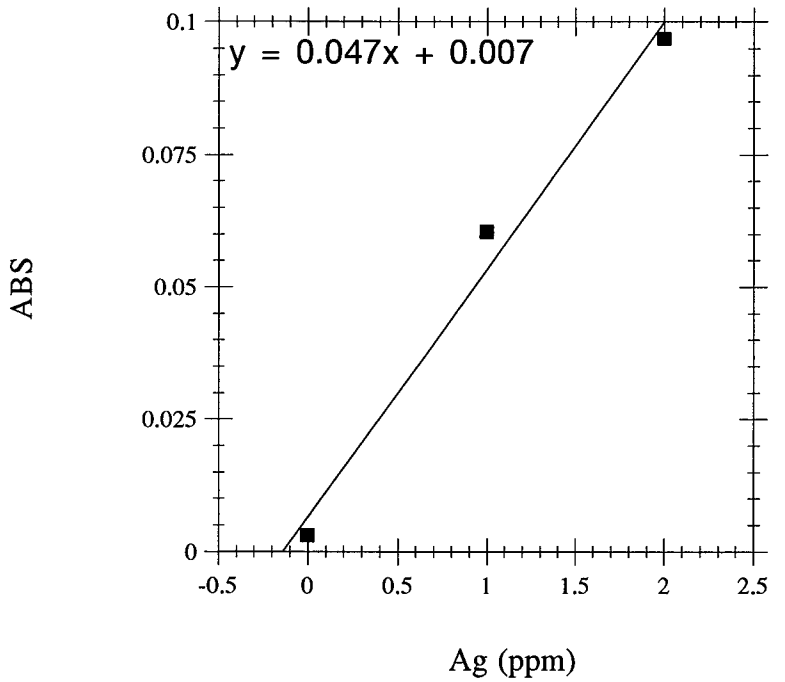
SAN-030 NaOAc



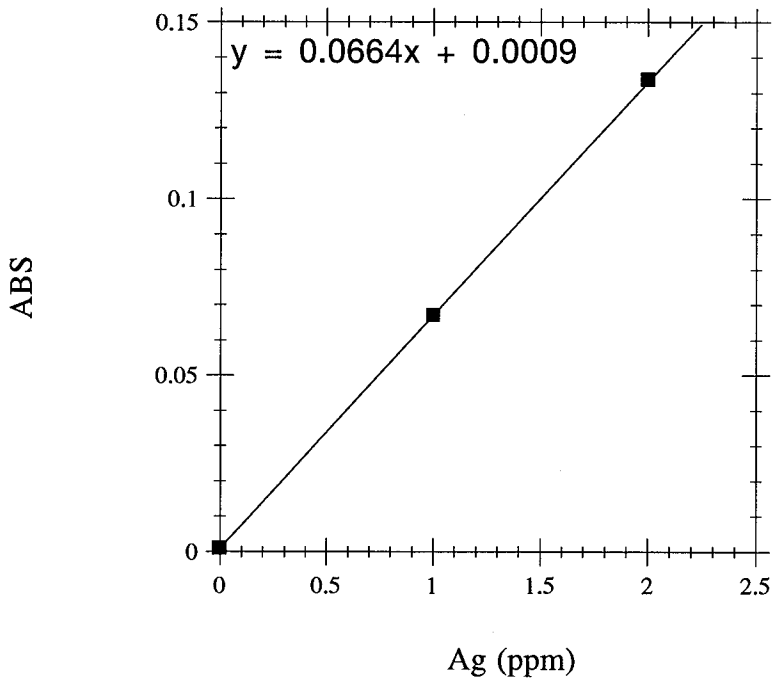

.0523 x 2 = .1046

$.1046 \times \frac{8}{1.022} = .819$ ppm

SAN-030 NaOAc



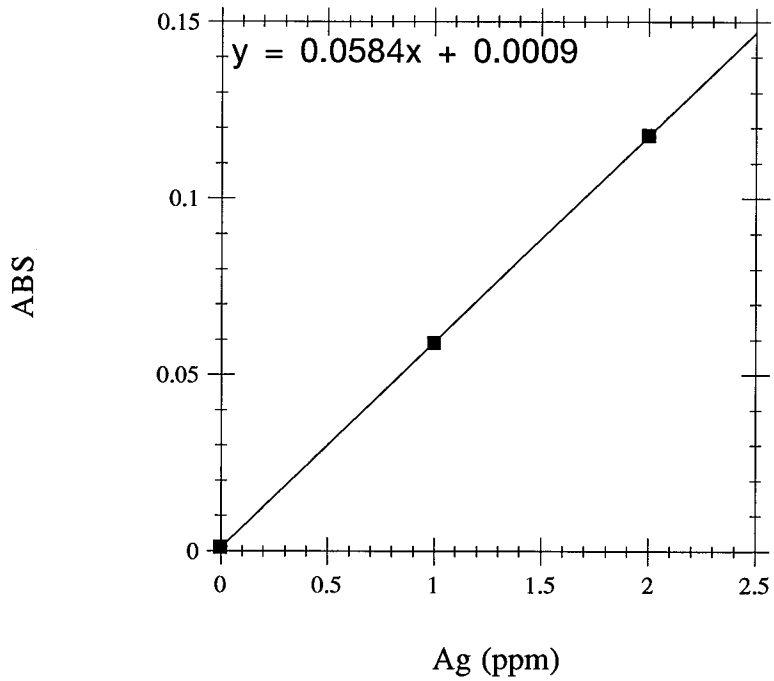
SAN-031 NaOAc




.0135 x 2 = .0270

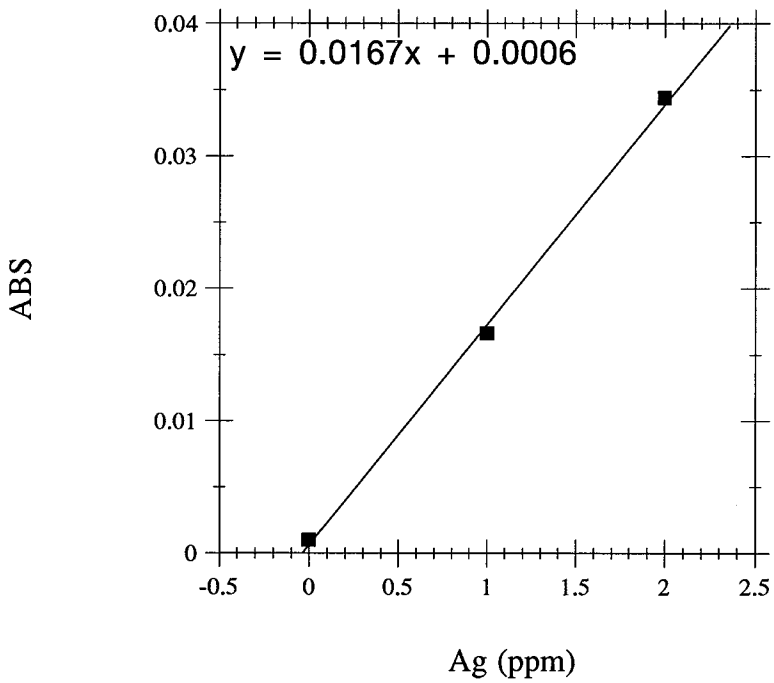
.027 + 8 / 1.026 = .210 ppm

SAN-032 NaOAc



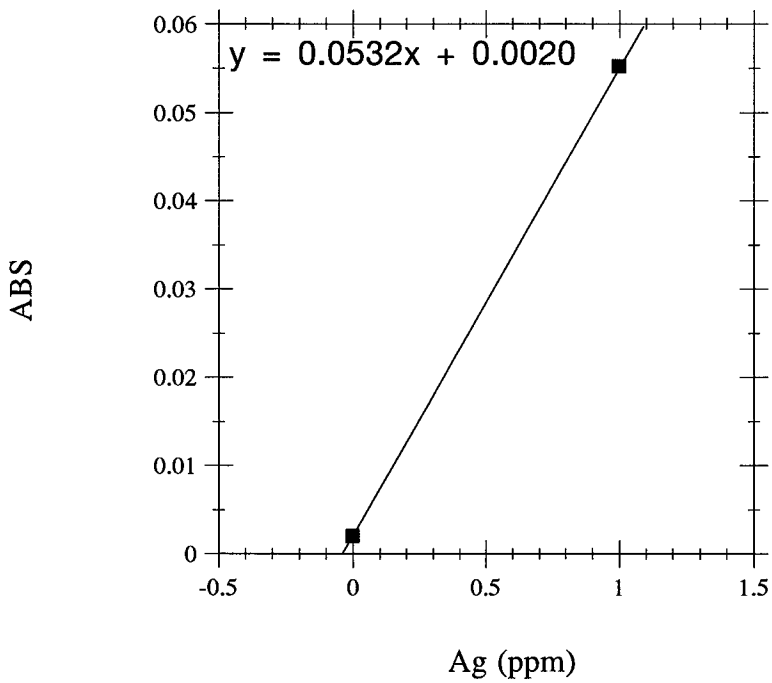

$.0154 \times 2 = .0308 \times \frac{8}{1.017} = .242$ ppm

SAN-033 NaOAc




.0359 x 2 = .0718 x 8/1.012 = .567 ppm

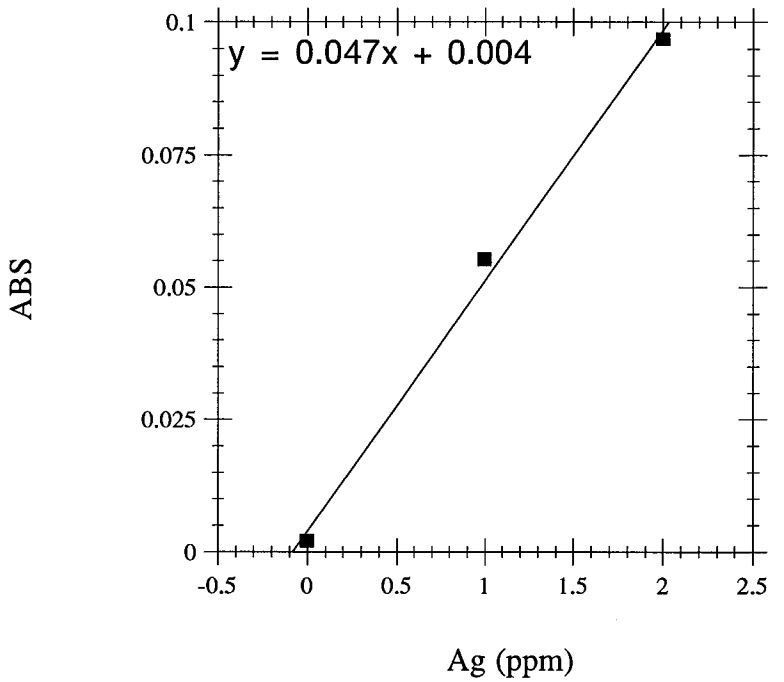
SAN-034 NaOAc



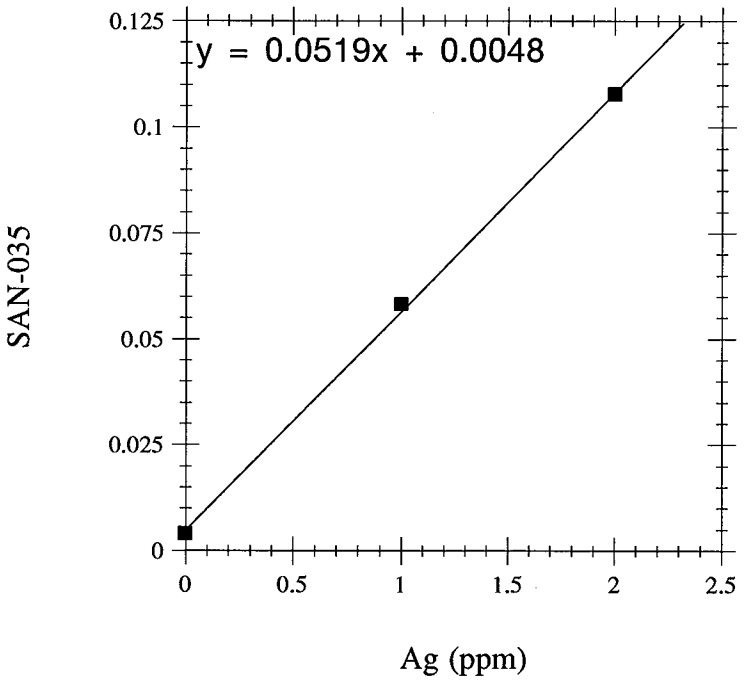

.0376 x 2 = .0752

.0752 x 8/1.009 = .596 ppm

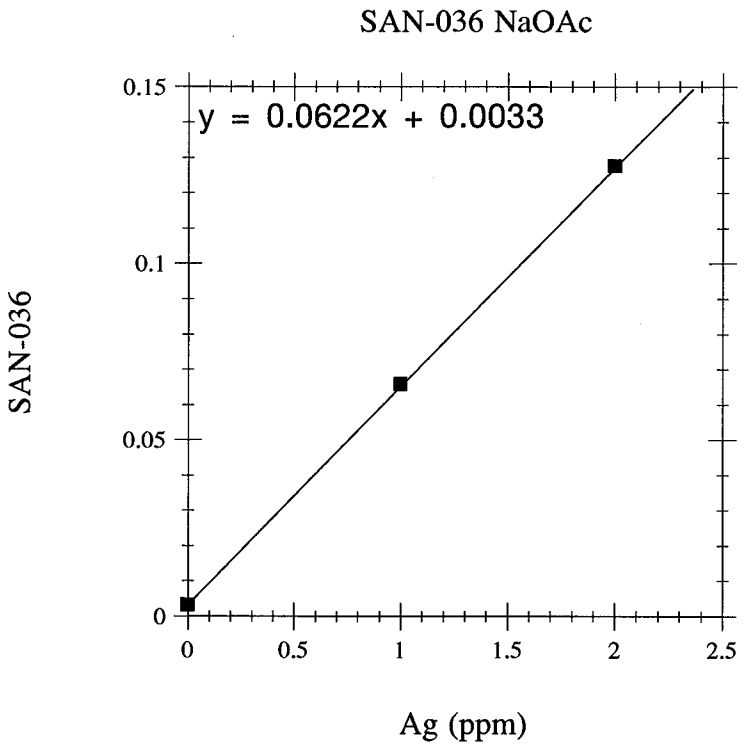
SAN-034 NaOAc



SAN-035 NaOAc

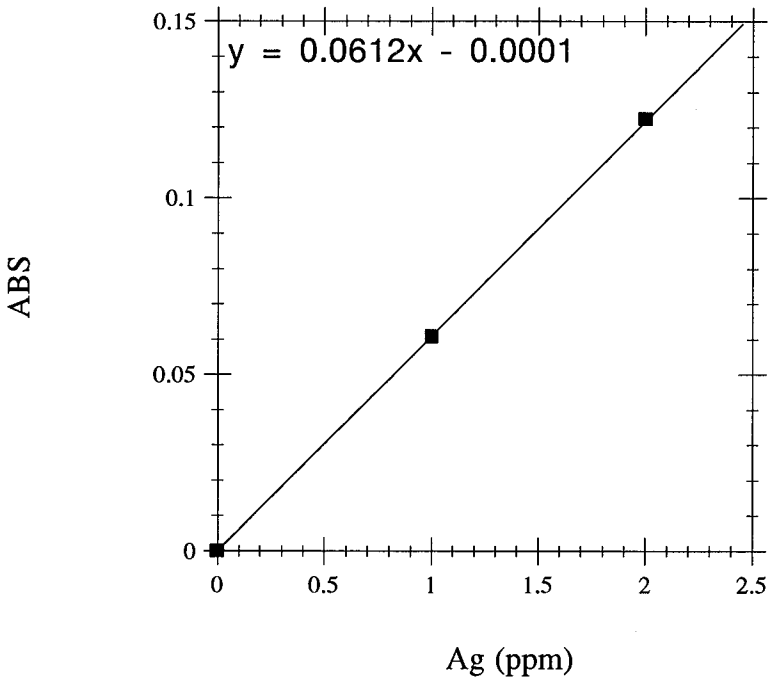



$.09252 = .1904 \times \frac{8}{1.02} = 1.493\ ppm$

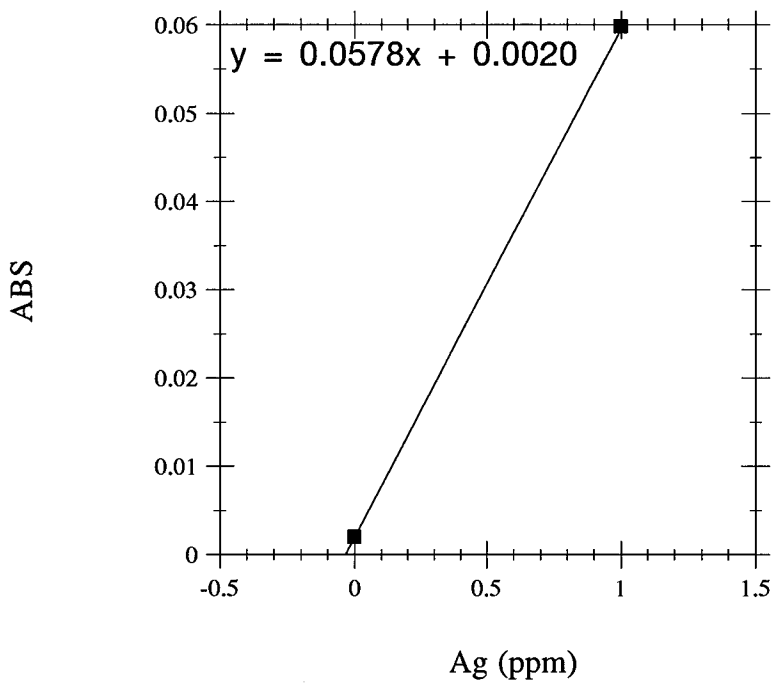



.0530 x 2 = .106 x 8 / .014 = .836 ppm

SAN-037 NaOAc



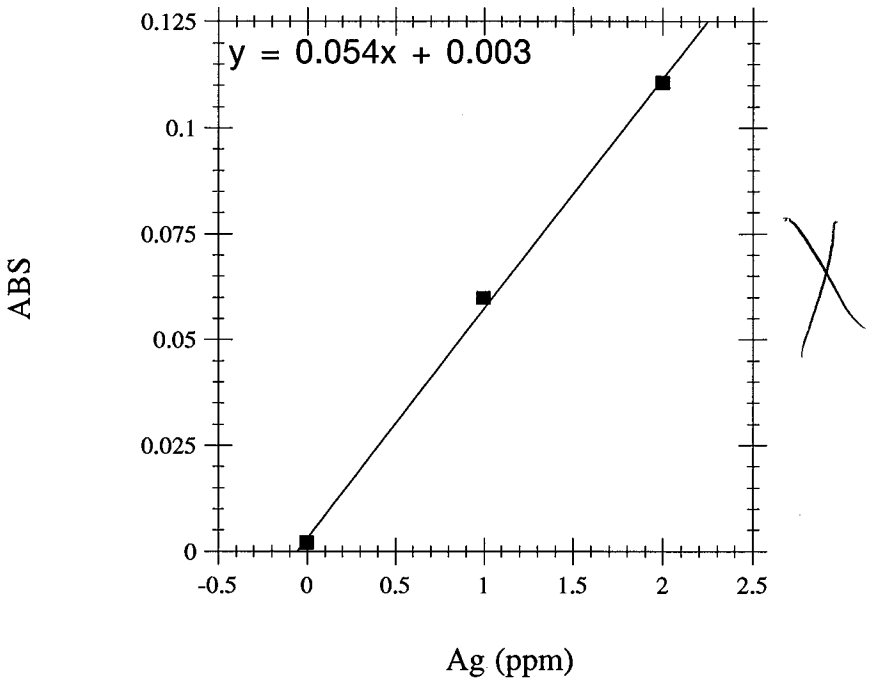
SAN-038 NaOAc



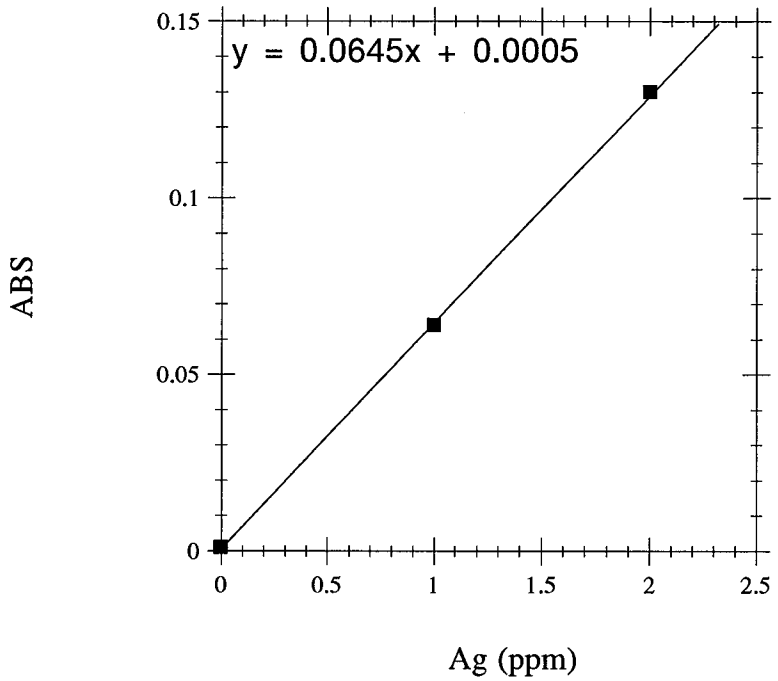

.0346 x 2 = .0692

$\frac{.0692 \times 8}{1.024} = .541$ ppm

SAN-038 NaOAc



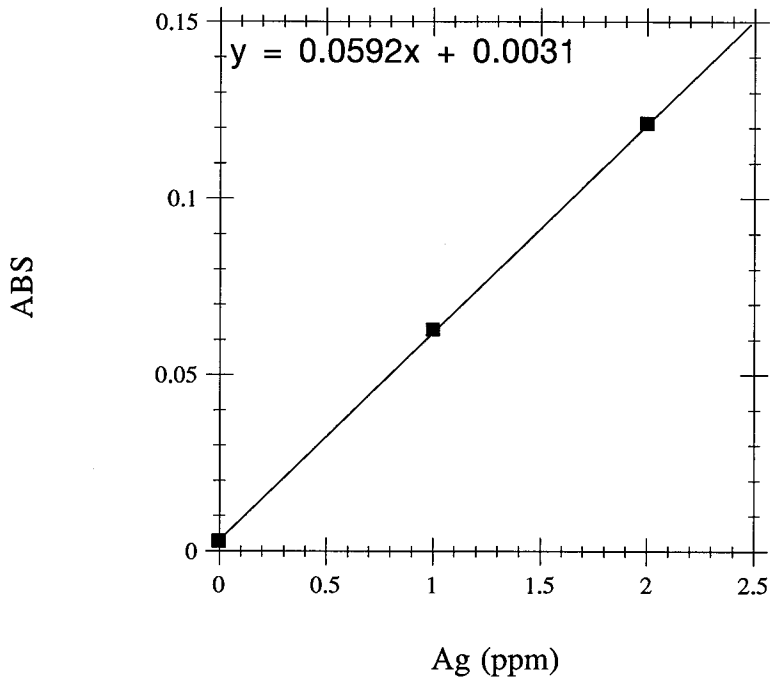
SAN-039 NaOAc




.0077 x 2 = .0154

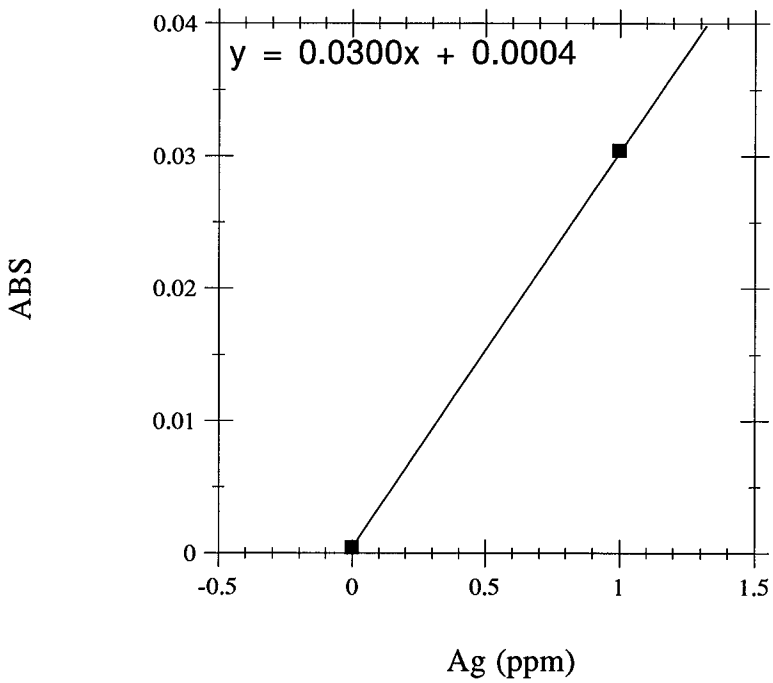
$\frac{.0154 \times 8}{1.018} = .121$ ppm

SAN-040 NaOAc



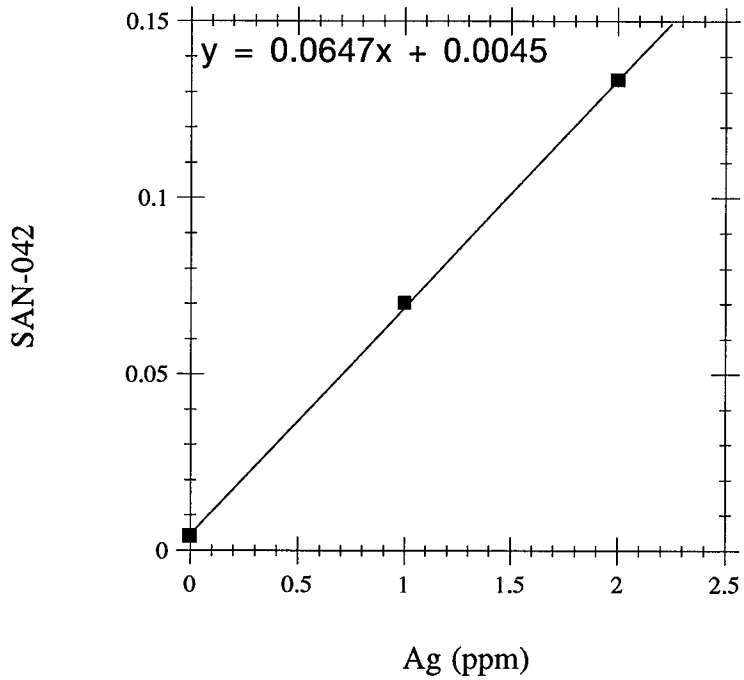

$.0524 \times 2 = .1048 \times \frac{8}{1.017} = .824$ ppm

SAN-041 NaOAc



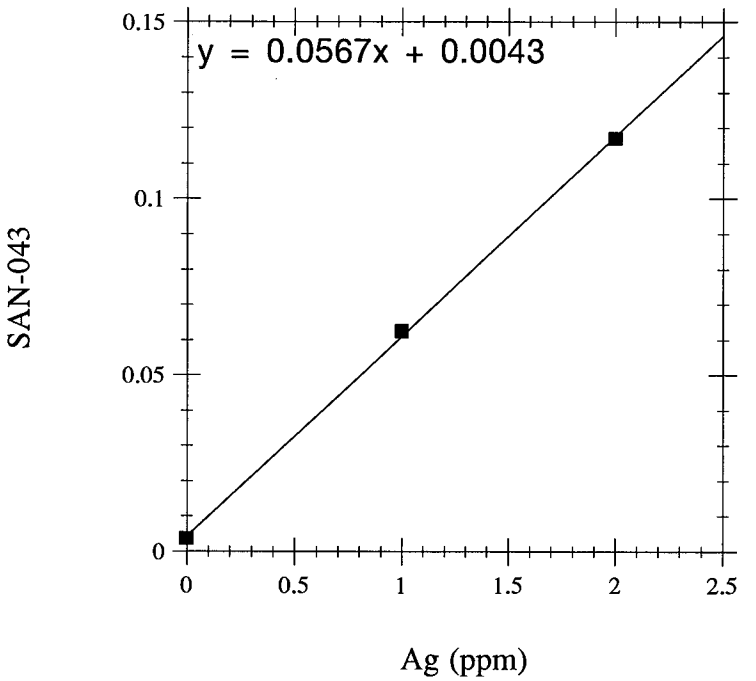

.0133 x 2 = .0266 x 8/1.015 = .209 ppm

SAN-042 NaOAc



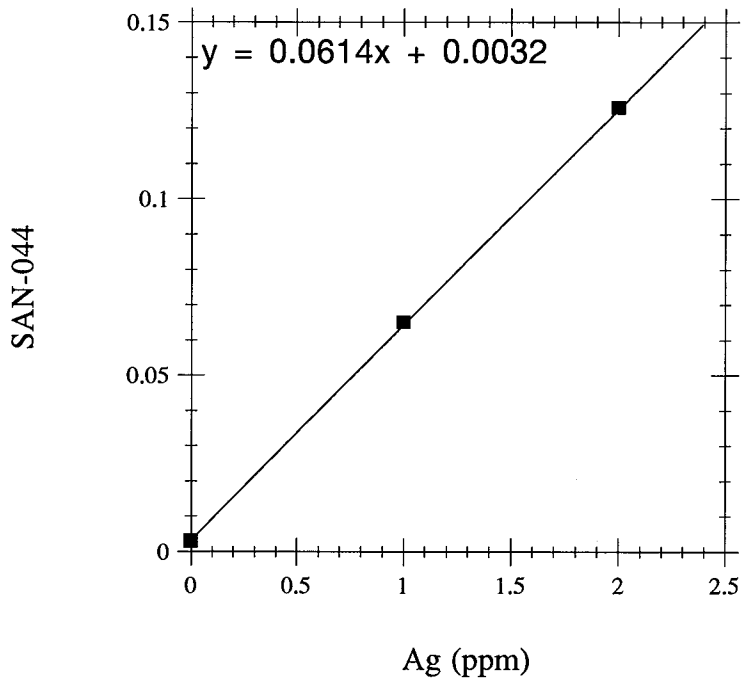

$.0695 \times 2 = .139 \times \frac{8}{1.012} = 1.098$ ppm

SAN-043 NaOAc



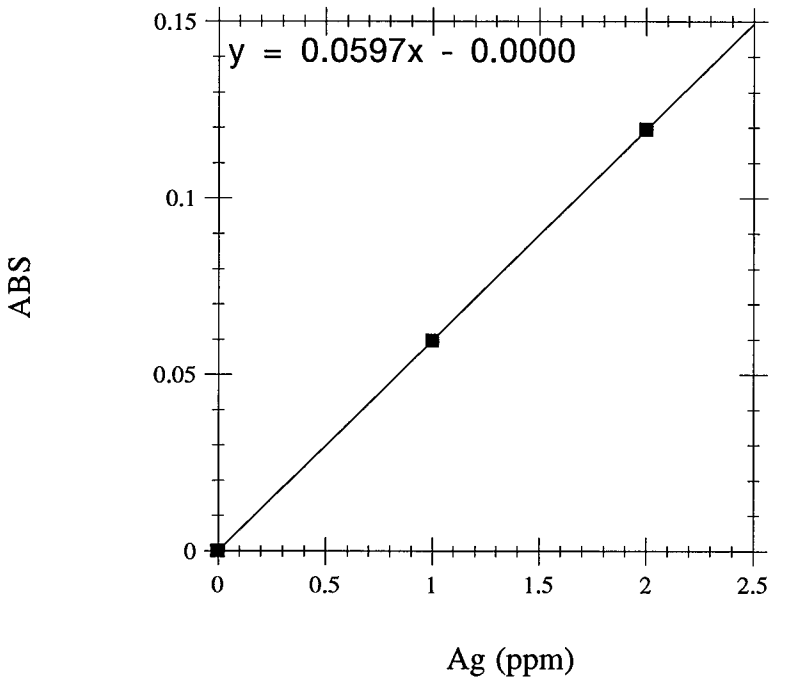

$.0758 \times 2 = .1516 \times \frac{8}{1.022} = 1.187\ ppm$

SAN-044 NaOAc

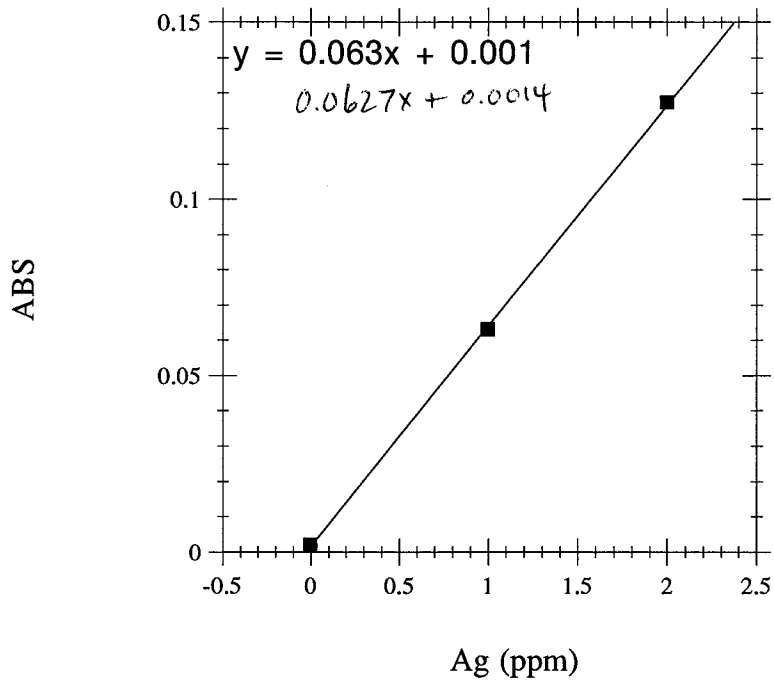



$.0521 \times 2 = .1042 + \frac{8}{1.014} = .822 ppm$

SAN-045 NaOAc



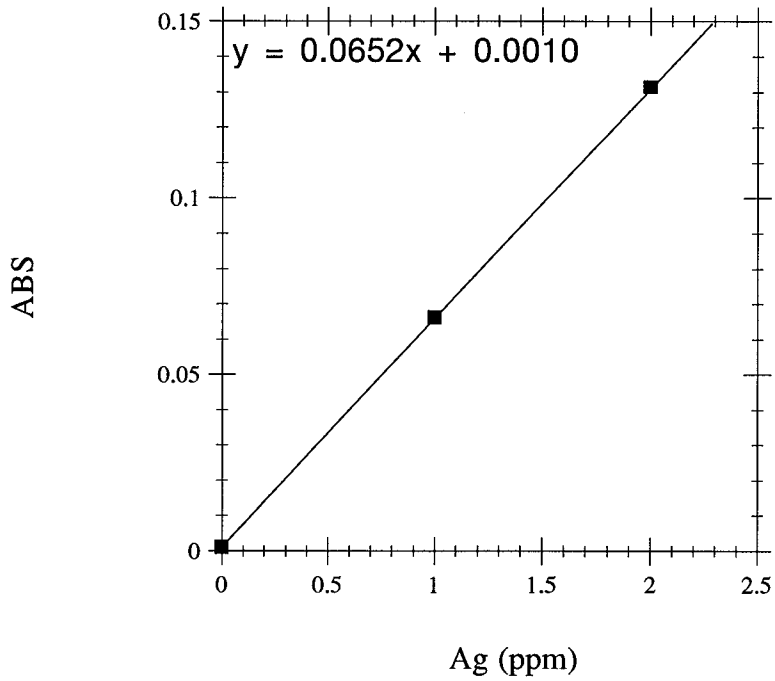
SAN-046 NaOAc




.0223 x 2 = .0446

$.0446 \times \frac{8}{1.022} = .349$ ppm

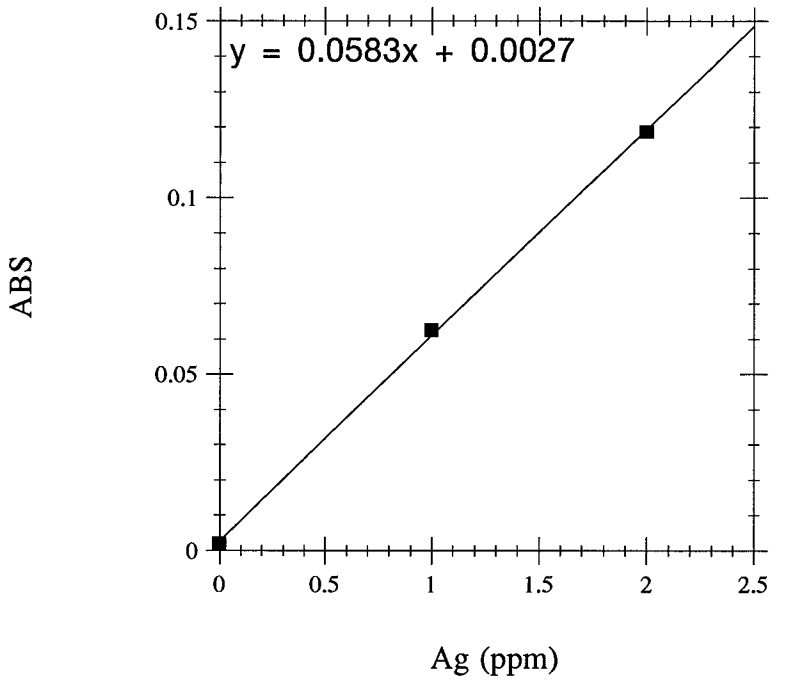
SAN-047 NaOAc




.0153 x 2 = .0306

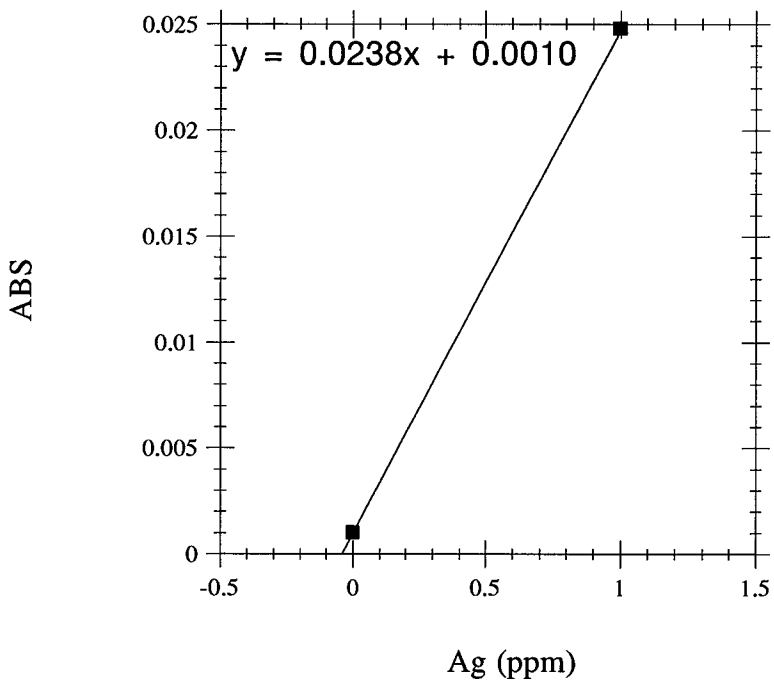
.0306 x 8 / 1.023 = .239 ppm

SAN-048 NaOAc



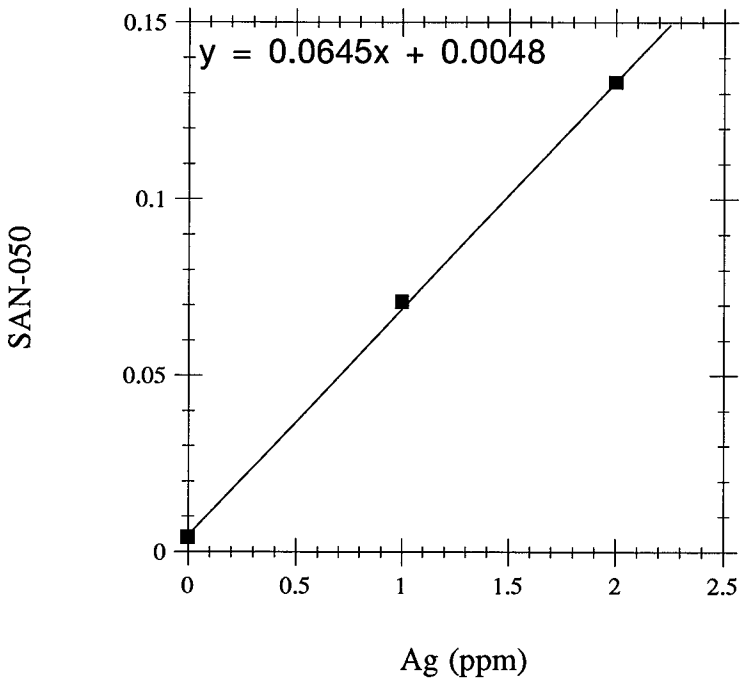

$.0463 \times 2 = .0926 \times \frac{8}{1.022} = .725$ ppm

SAN-049 NaOAc



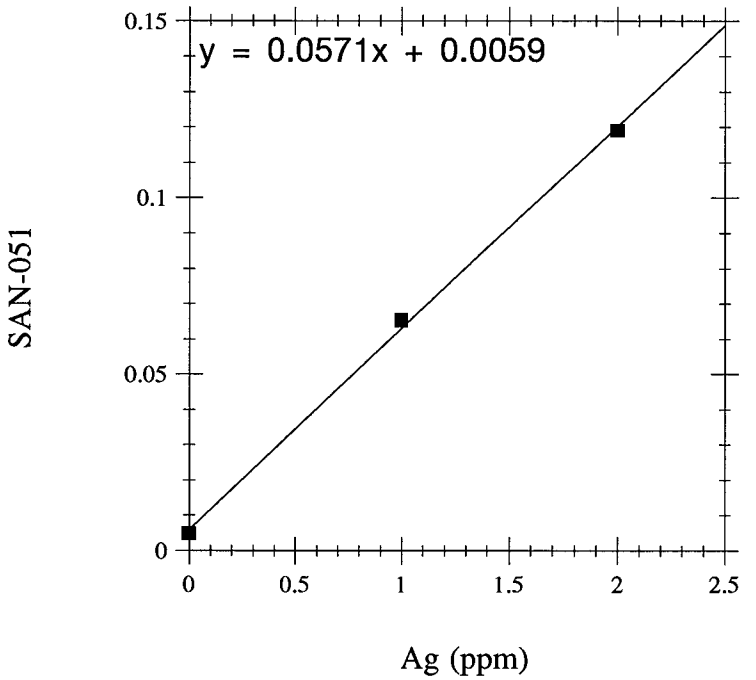

$.0420 \times 2 = .084 \times \frac{8}{1.017} = .661$ ppm

SAN-050 NaOAc



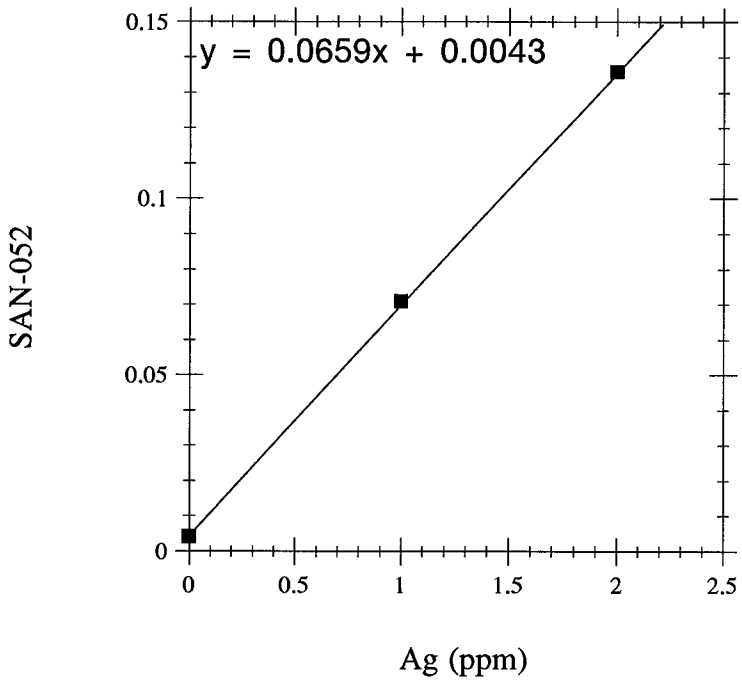

$.0744 \times 2 = .1488 \times \frac{8}{1.016} = 1.172$ ppm

SAN-051 NaOAc



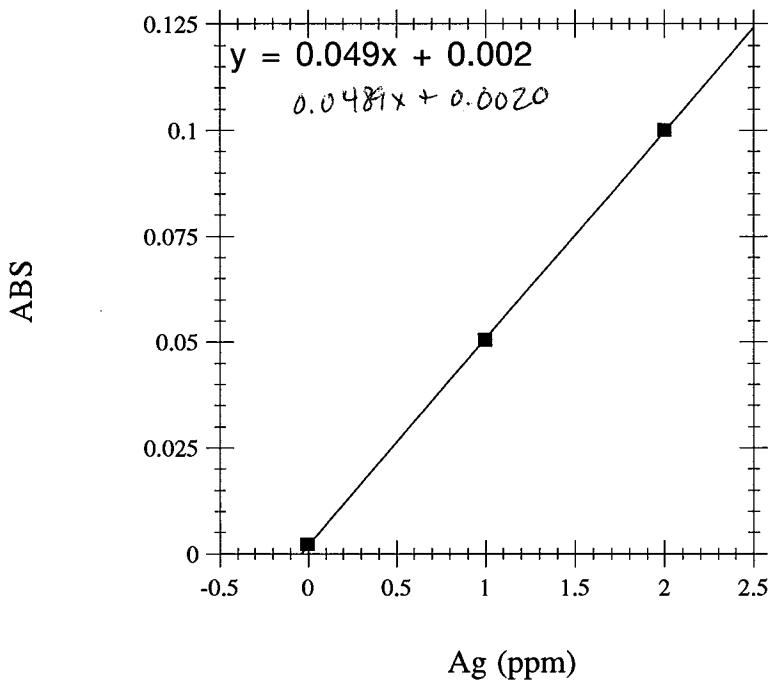

$.1033 \times 2 = .2066 \times \frac{8}{1.017} = 1.625\ ppm$

SAN-052 NaOAc




$.0652 \times 2 = .1304 \times \frac{8}{1.02} = \underline{1.023 \text{ ppm}}$

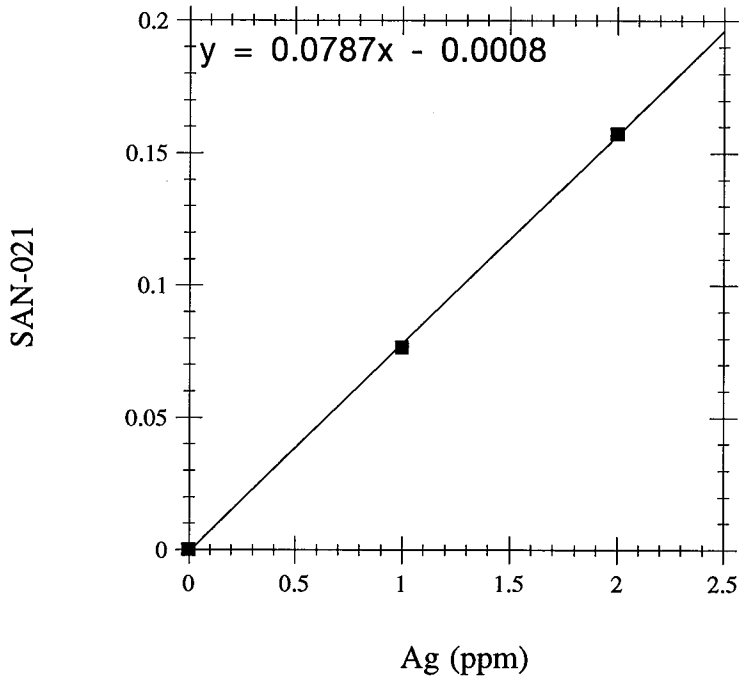
SAN-053 NaOAc



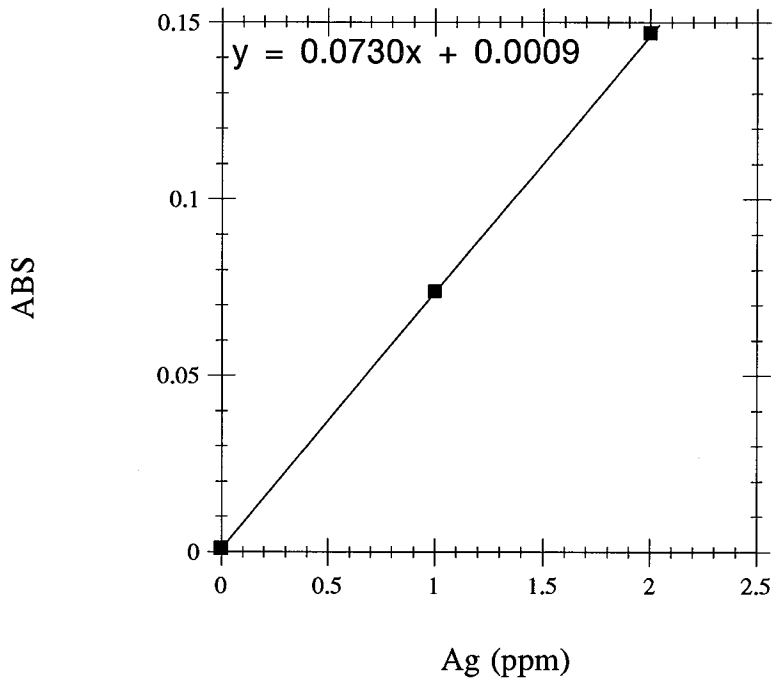

.0409 x 2 = .0818

$\frac{.0818 \times 8}{1.008} = .649$ ppm

SAN-021 NH2OH



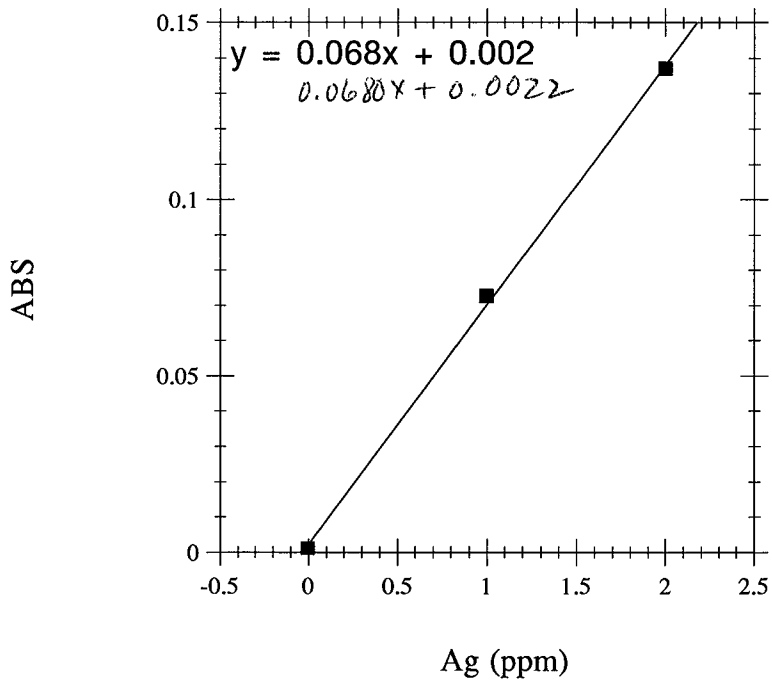
SAN-022 NH2OH




.0123 x 2 = .0246

$\frac{.0246 \times 8}{1.022} = .192$ ppm

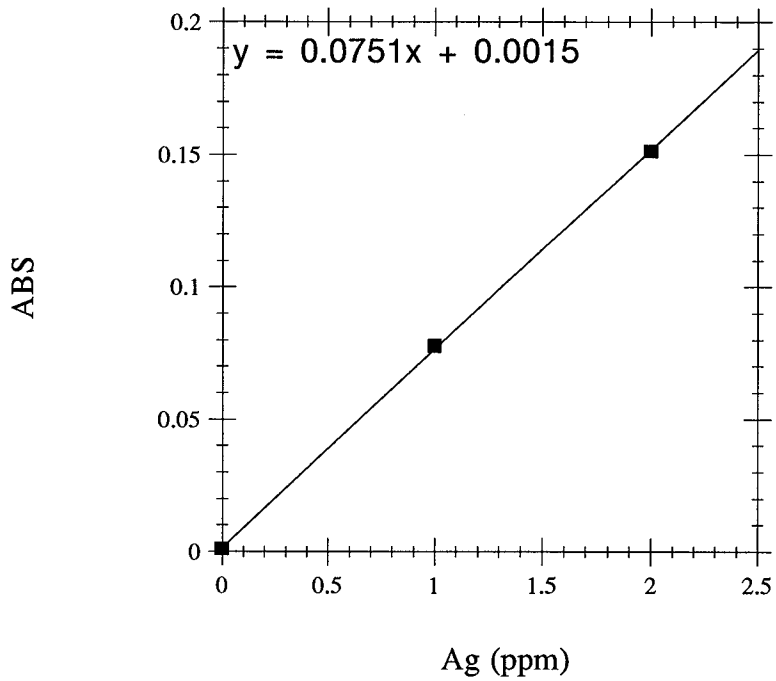
SAN-023 NH2OH




.0323 x2 = .0646

$.0646 \times \frac{8}{1022} = .506$ ppm

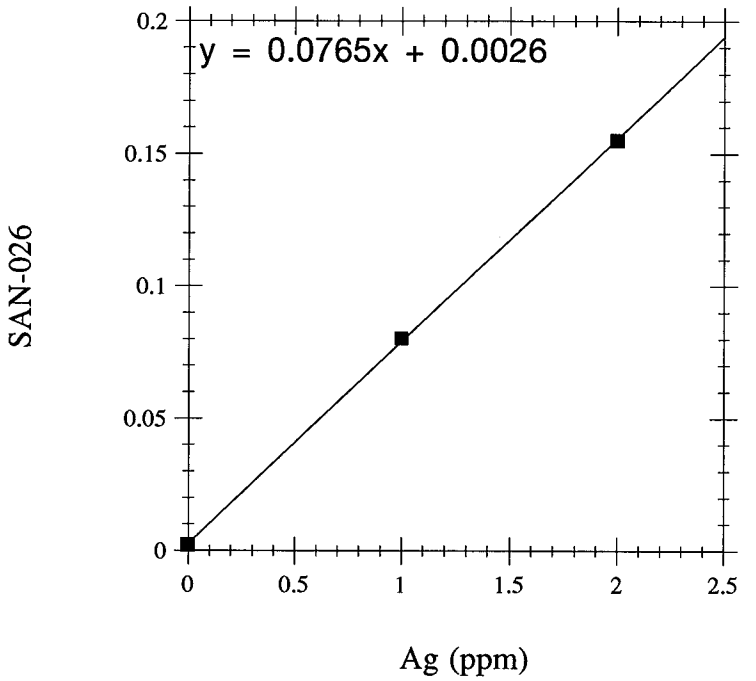
SAN-024 NH2OH




.0199 x 2 = .0398

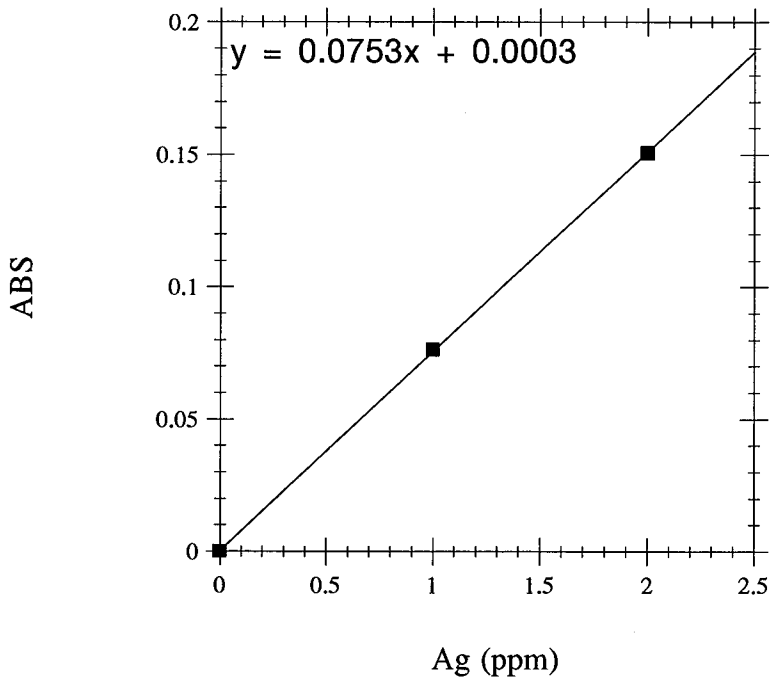
$\frac{.0398 \times 8}{1.018} = .313$ ppm

SAN-026 NH2OH



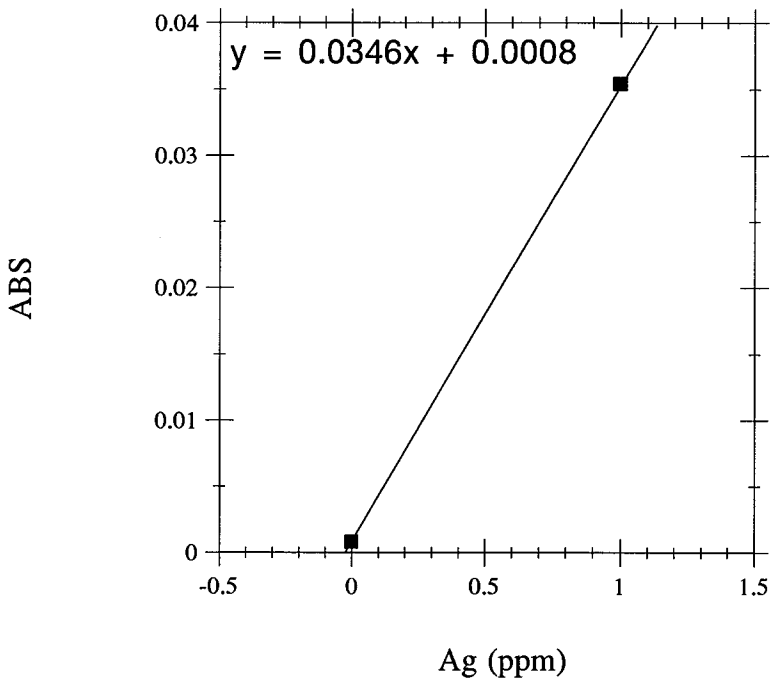

$.034 \times 2 = .068 \times \frac{8}{1.021} = .533 ppm$

SAN-025 NH2OH



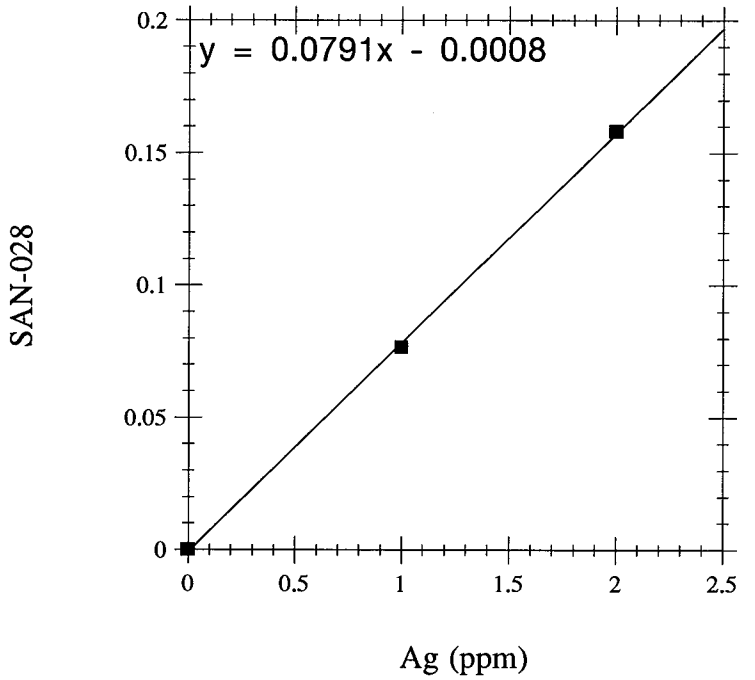

$.604 \times 2 = .008 \times \frac{8}{1.025} = .062$ ppm

SAN-027 NH2OH

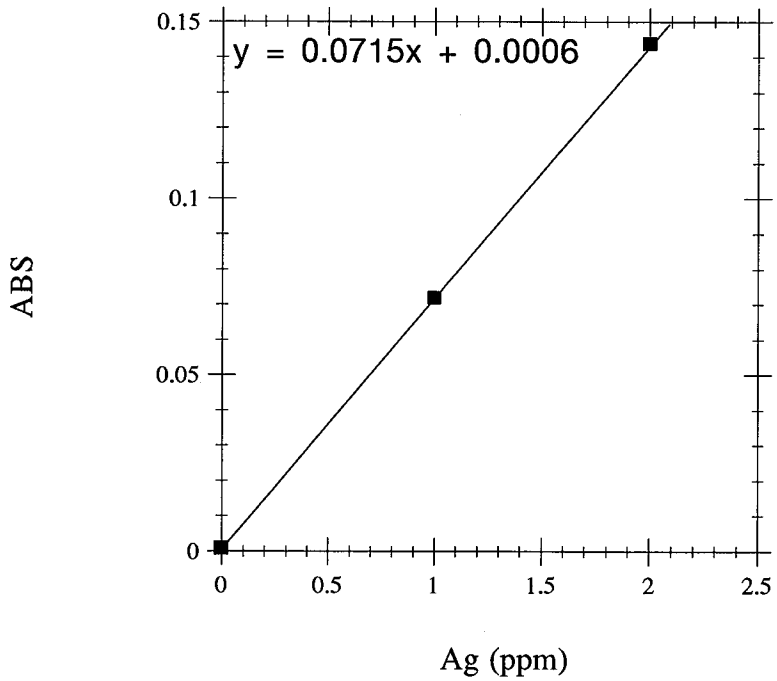



.0231 x 2 = .0462 x 8/1.013 = .365 ppm

SAN-028 NH2OH



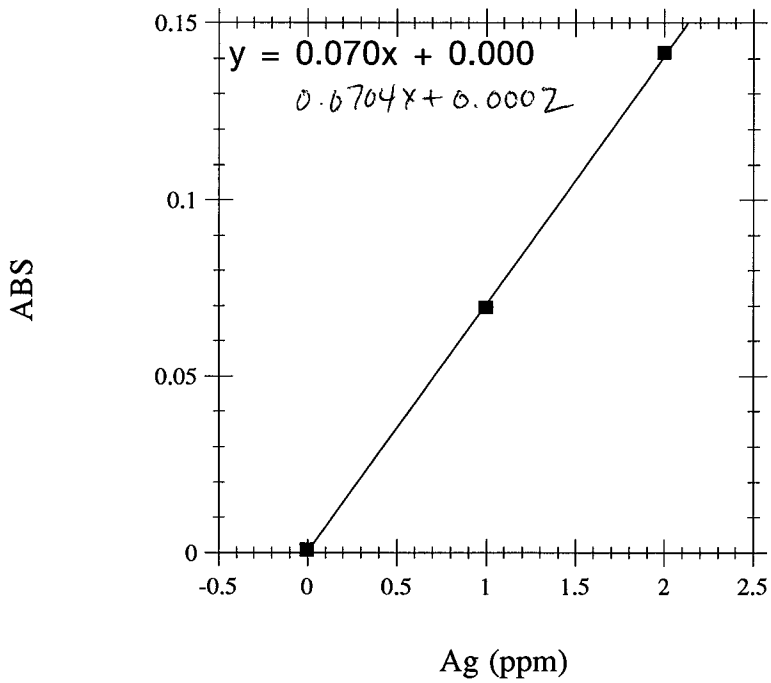
SAN-029 NH2OH




.0084 x 2 = .0168

$\frac{.0168 \times 8}{1.02} = .132$ ppm

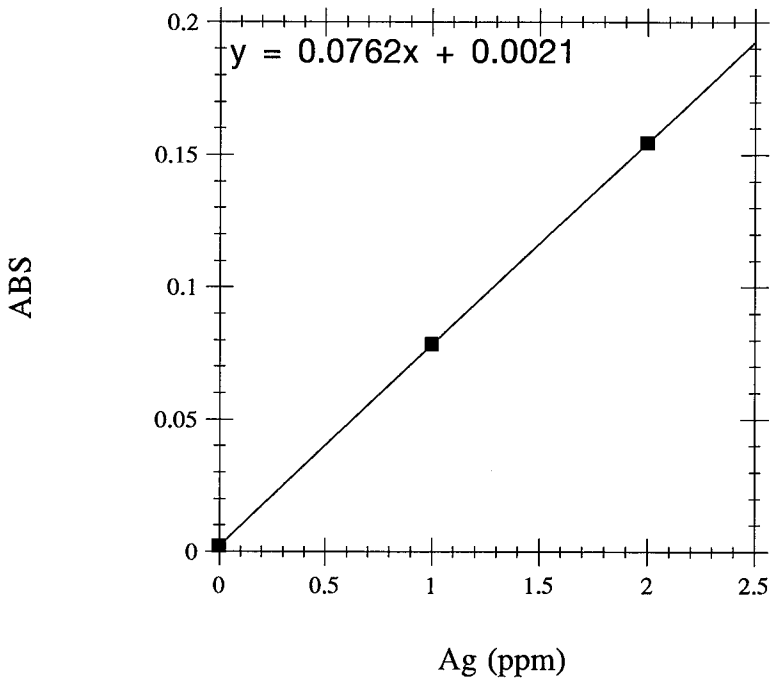
SAN-030 NH2OH




.0028 x2 = .0056

.0056 x 8/1.022 = .044 ppm

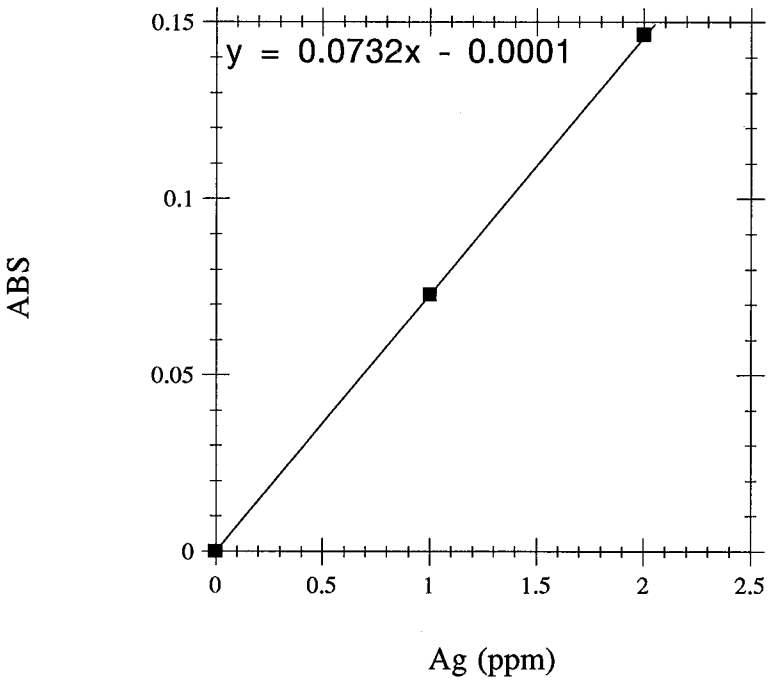
SAN-031 NH2OH




.0276 x 2 = .0552

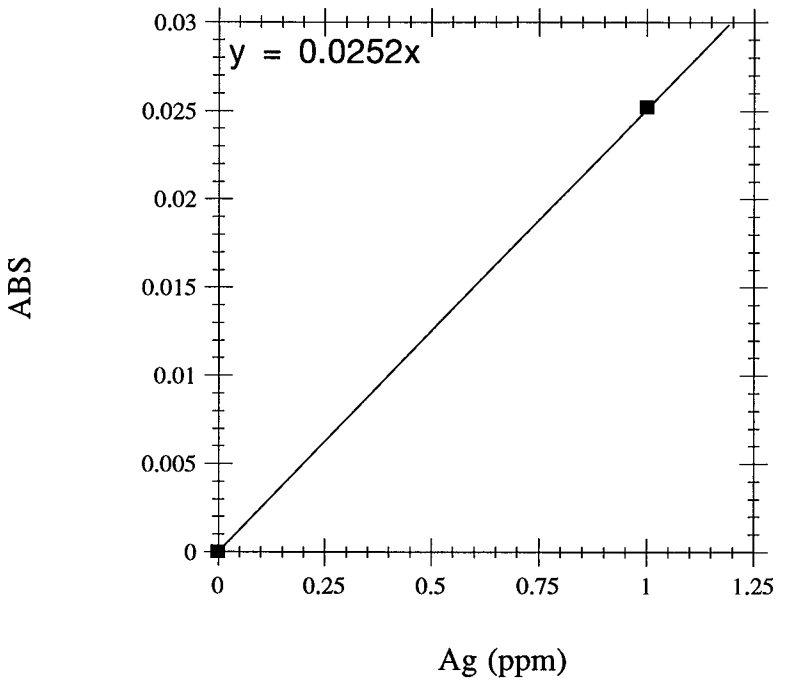
$\frac{.0552 + 8}{1.026} = .43$ ppm

SAN-032 NH2OH



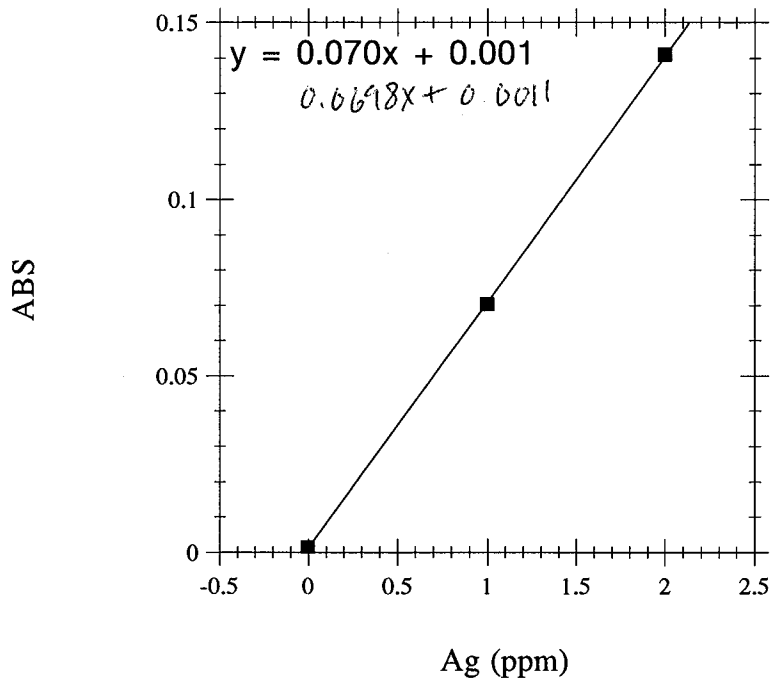

0

SAN-033 NH2OH




0 ppm

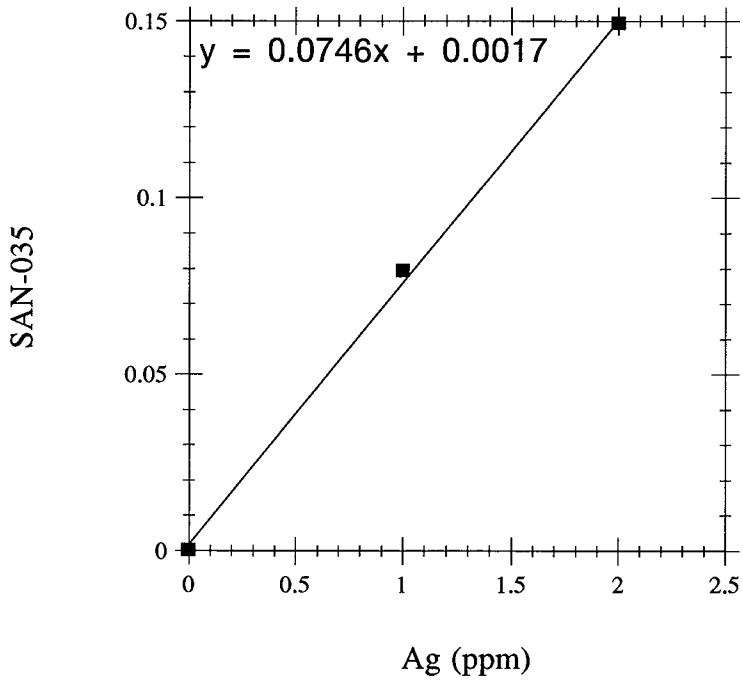
SAN-034 NH2OH




.0157 x 2 = .0314

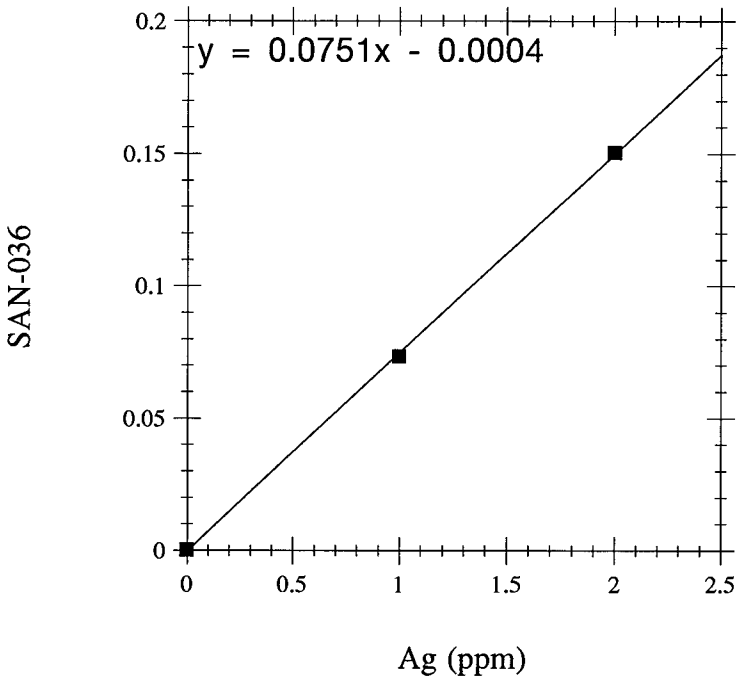
.0314 x 8/1.009 = .249 ppm

SAN-035 NH2OH

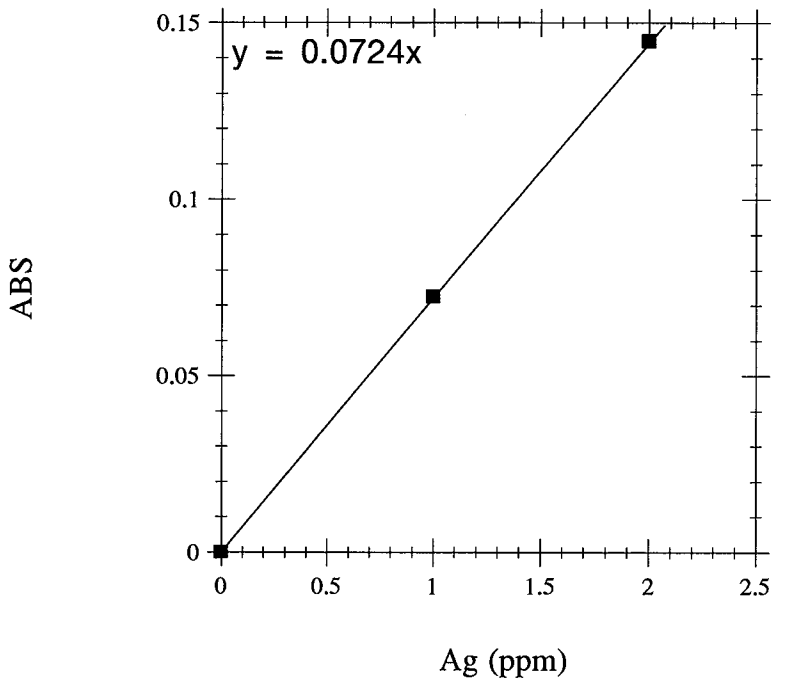



$.0228 \times 2 = .0456 \times \frac{8}{1.02} = .3576$ ppm

SAN-036 NH2OH

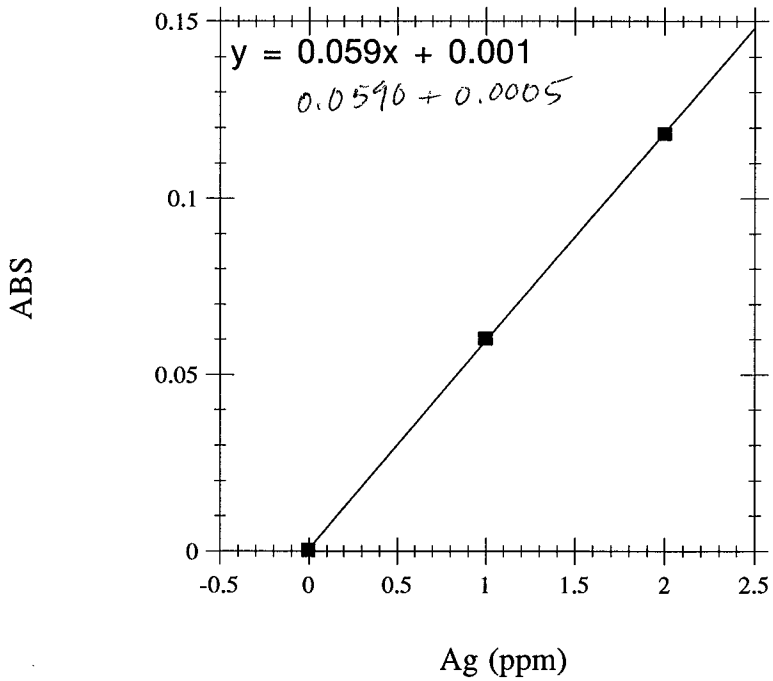


SAN-037 NH2OH




0

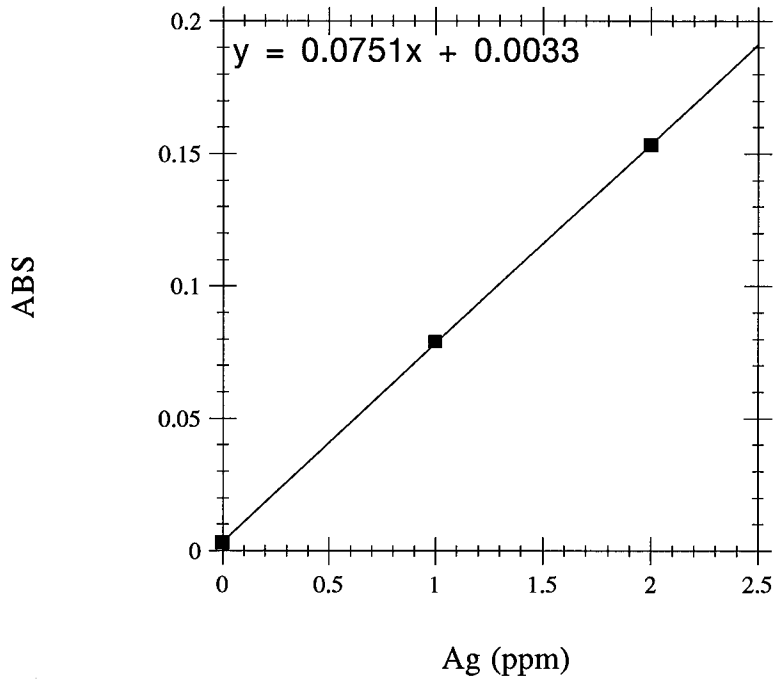
SAN-038 NH2OH




.0085 x 2 = .017

$.017 \times \frac{8}{1.024} = .133$ ppm

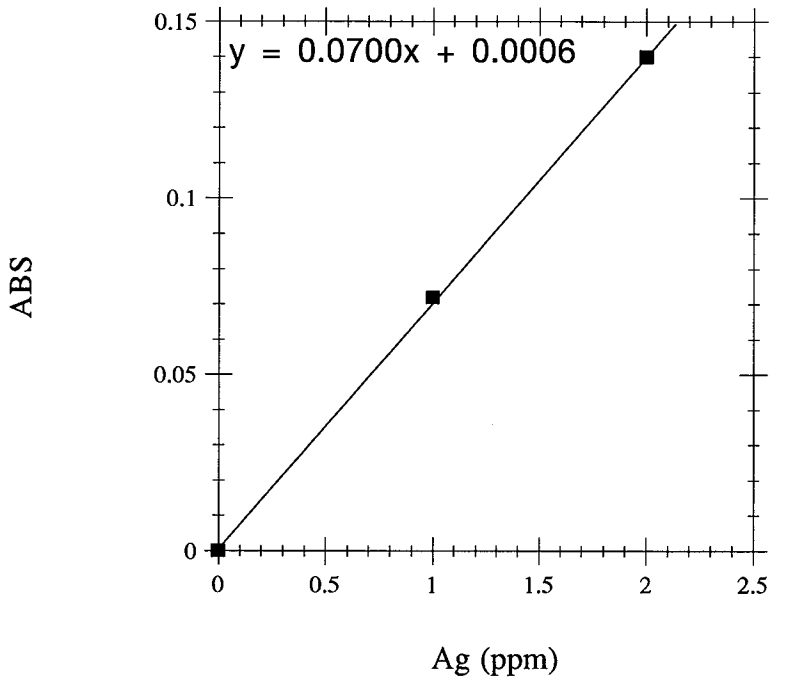
SAN-039 NH2OH




.0439 x 2 = .0878

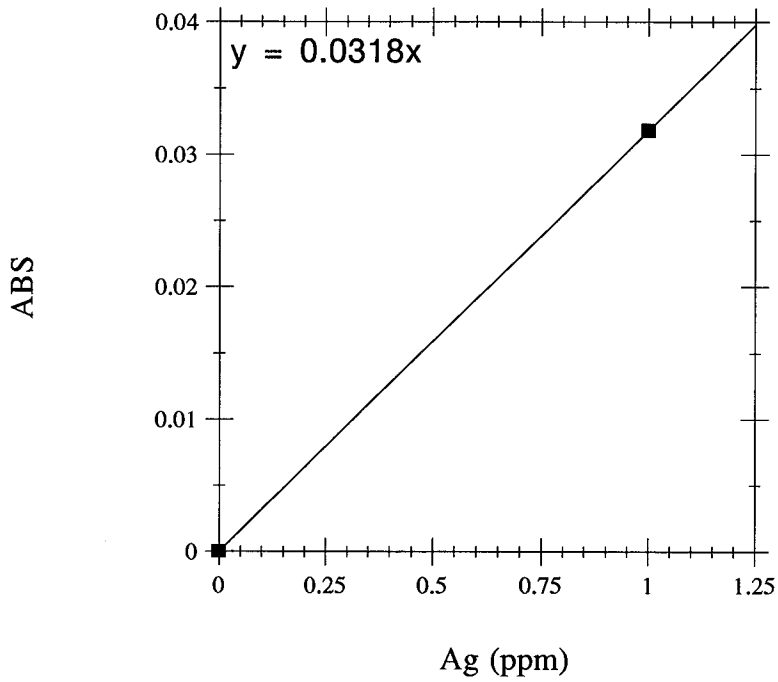
$\frac{.0878 \times 8}{1.018} = .69$ ppm

SAN-040 NH2OH

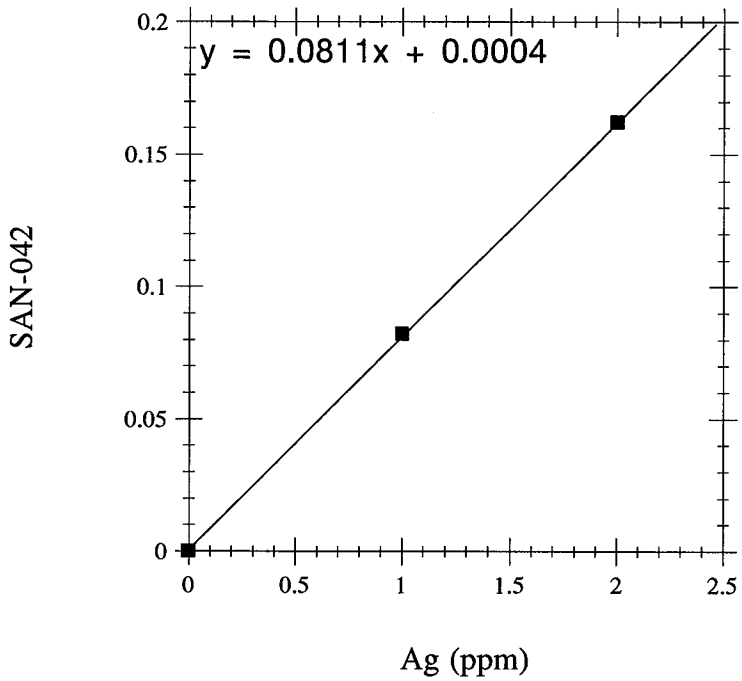



$.0086 \times 2 = .0172 \times \frac{8}{1.017} = .135$ ppm

SAN-041 NH2OH

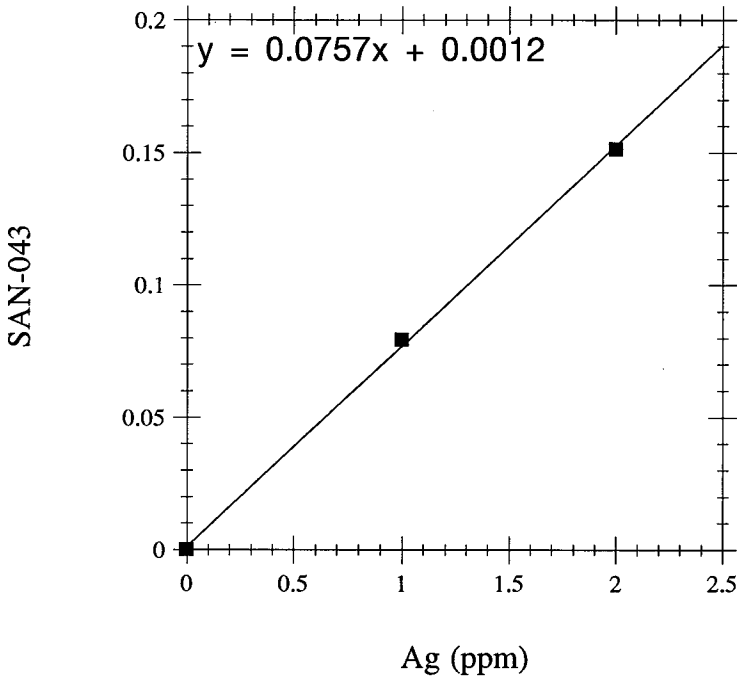


SAN-042 NH2OH



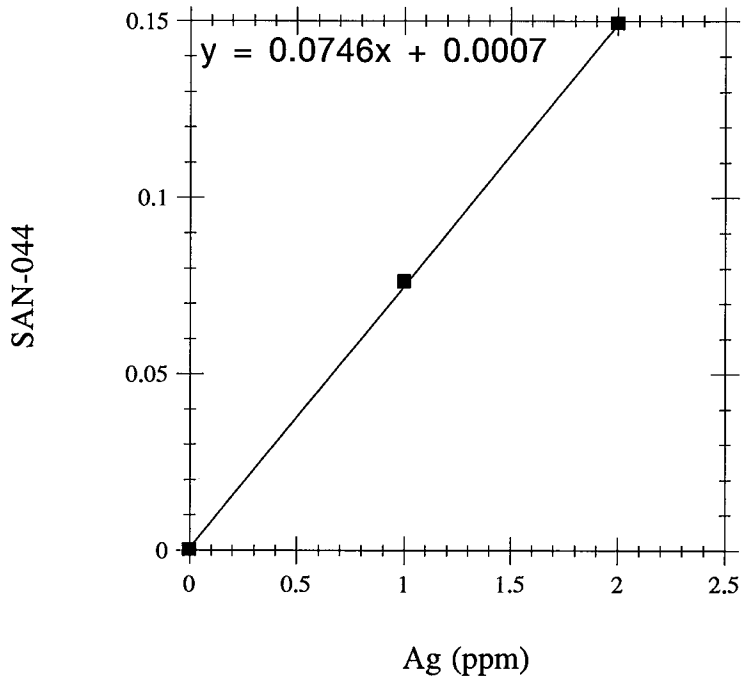

.00492 = .00988 × 8 / 1.012 = .0774 ppm

SAN-043 NH2OH



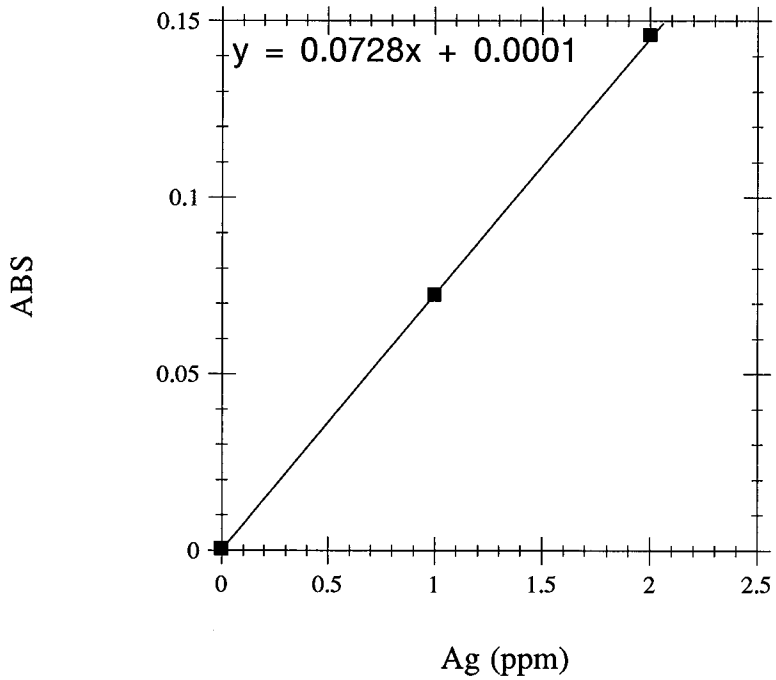

$.0158 \times 2 = .0316 \times \frac{8}{1.022} = .247$ ppm

SAN-044 NH2OH




.0094 x 2 = .0188 x 8/1.014 = .148 ppm

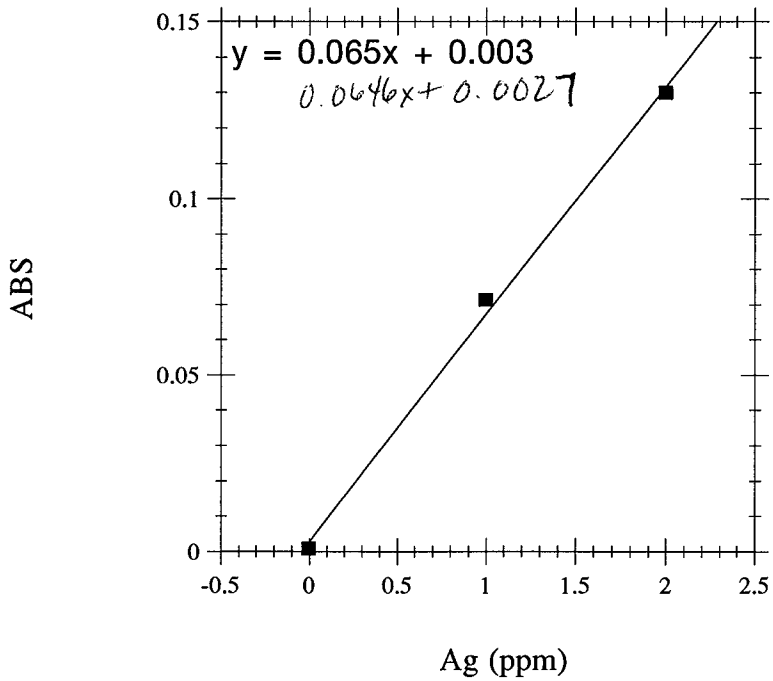
SAN-045 NH2OH




.0014 x 2 = .0028

$\frac{.0028 \times 8}{1.017} = .022$ ppm

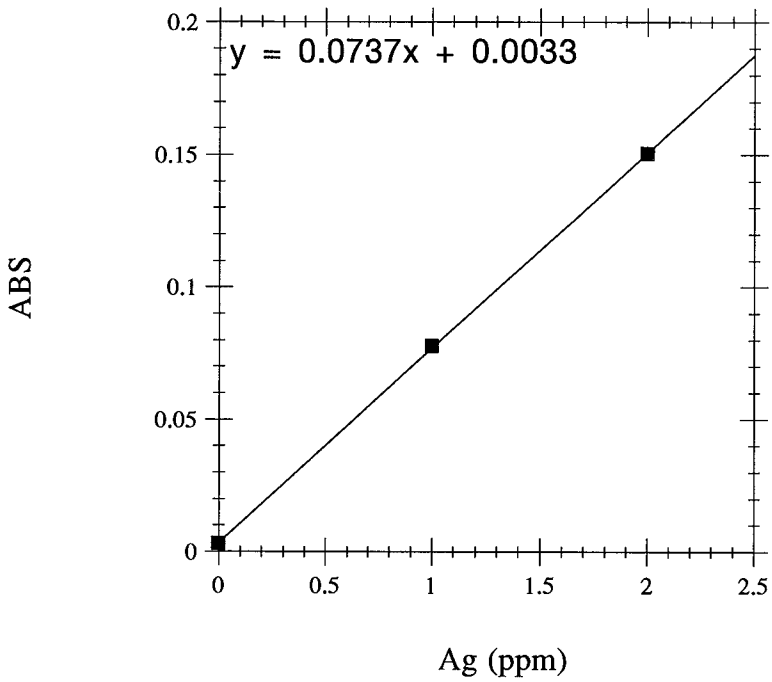
SAN-046 NH2OH




.0418 x 2 = .0836

$.0836 \times \frac{8}{1.022} = .654$ ppm

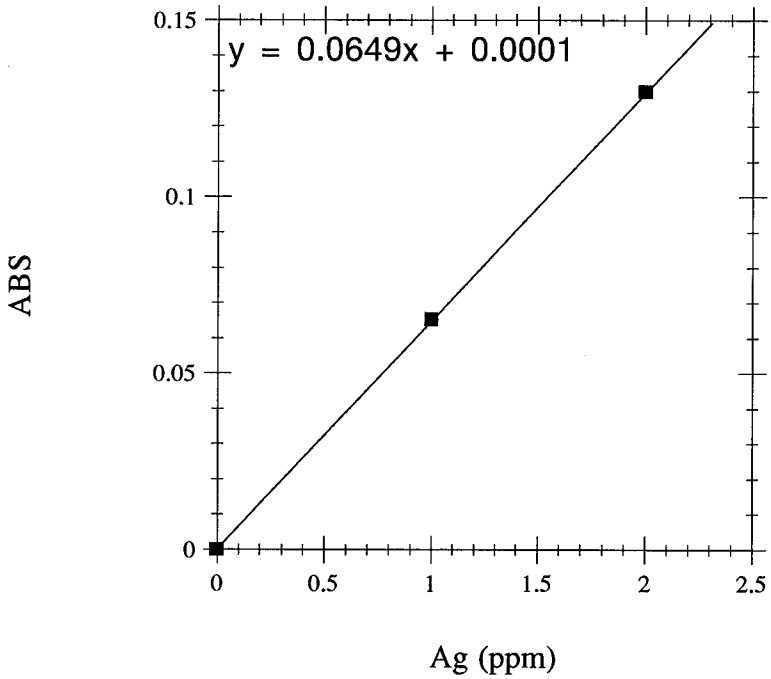
SAN-047 NH2OH




.0448 x 2 = .0896

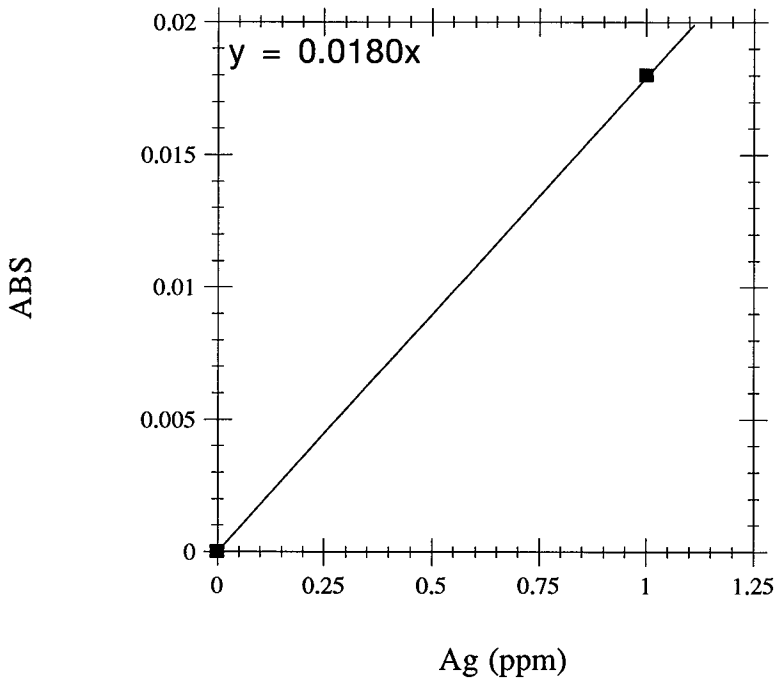
.0896 x 8 / 1.023 = .700 ppm

SAN-048 NH2OH

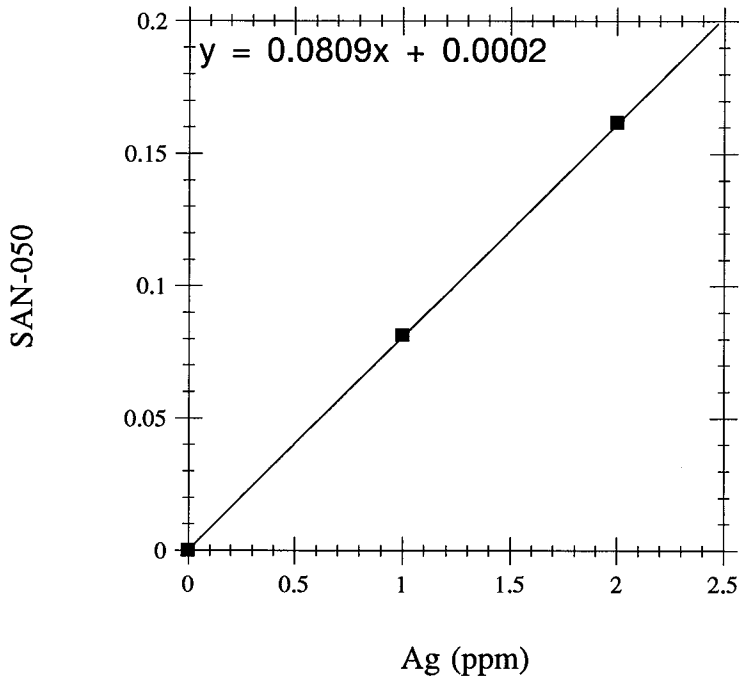



$.0015 \times 2 = .003 \times \frac{8}{1.022} = .023\ ppm$

SAN-049 NH2OH

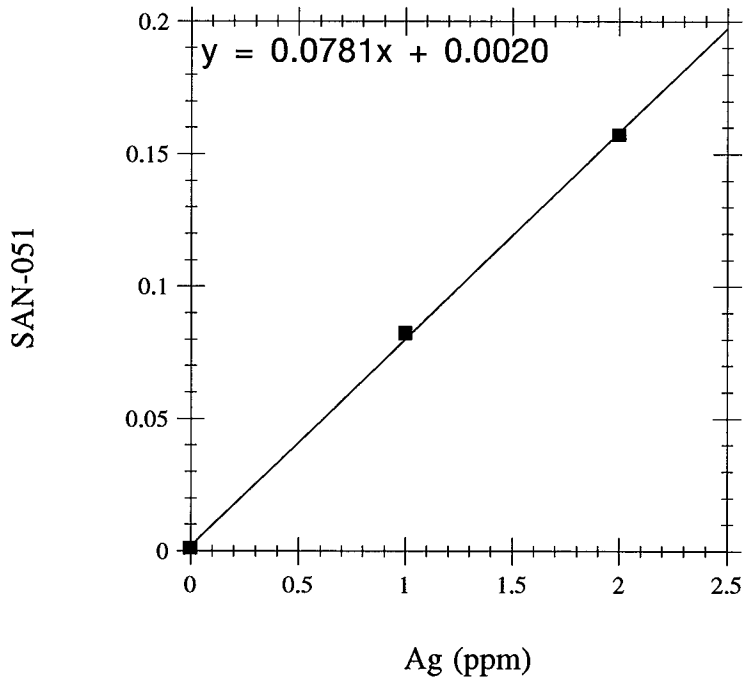


SAN-050 NH2OH



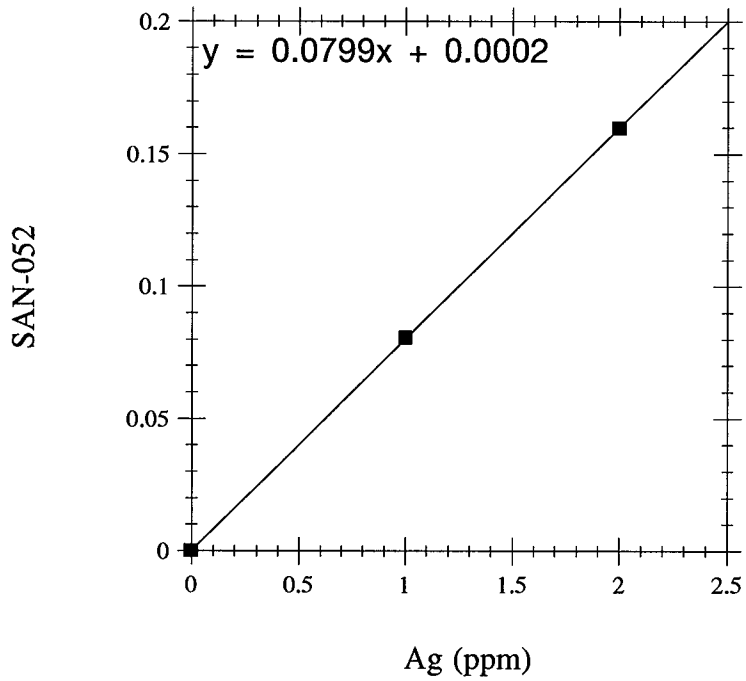

$.0025 \times 2 = .005 \times \frac{8}{1.016} = .041 ppm$

SAN-051 NH2OH



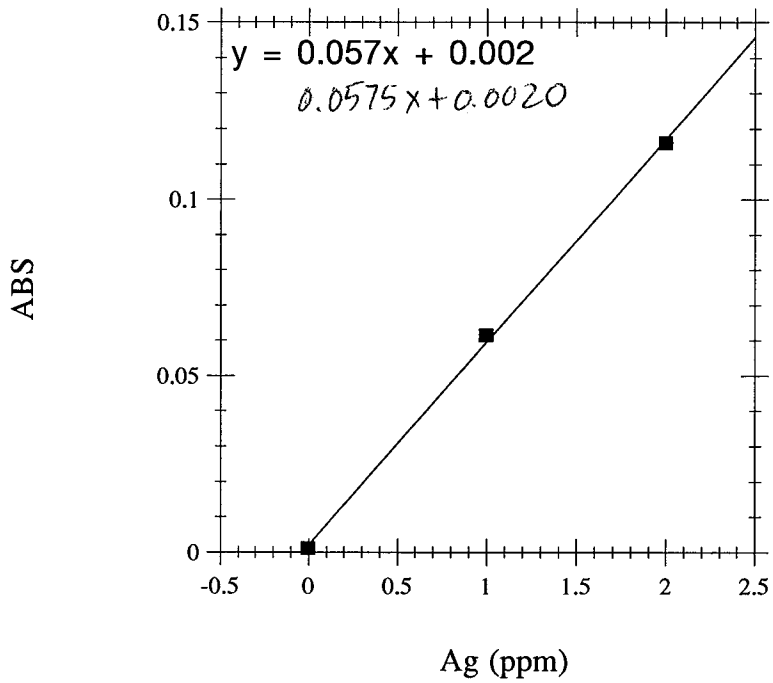

$.0256 \times 2 = .0512 \times \frac{8}{1.017} = .403 ppm$

SAN-052 NH2OH




$.0025 \times 2 = .005 \times \frac{8}{1.02} = .039$ ppm

SAN-053 NH2OH

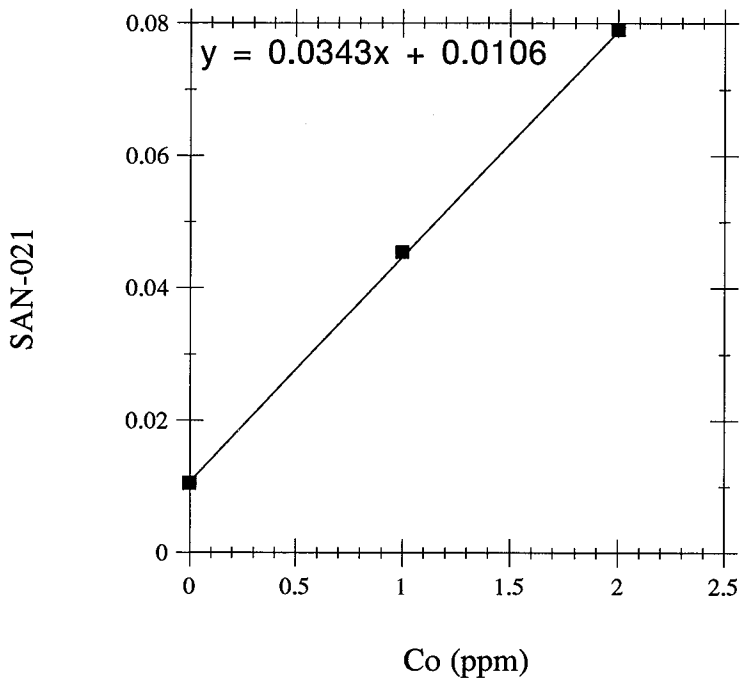



.0348x2 = .0696

$\frac{.0696 \times 8}{1.008} = .552$ ppm

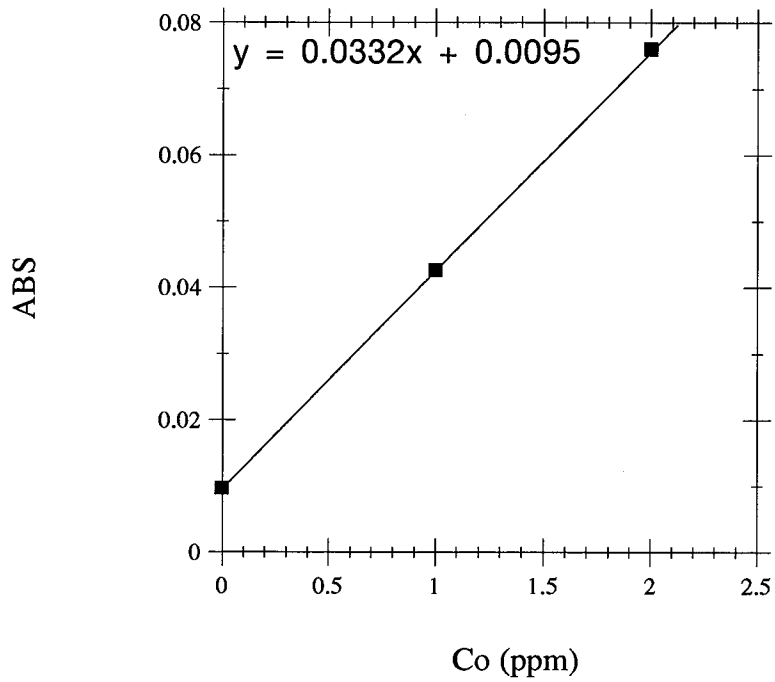
Co data

SAN-021 MgCl2




$.3090 \times 2 = .618 \times \frac{8}{1.016} = 4.866$ ppm

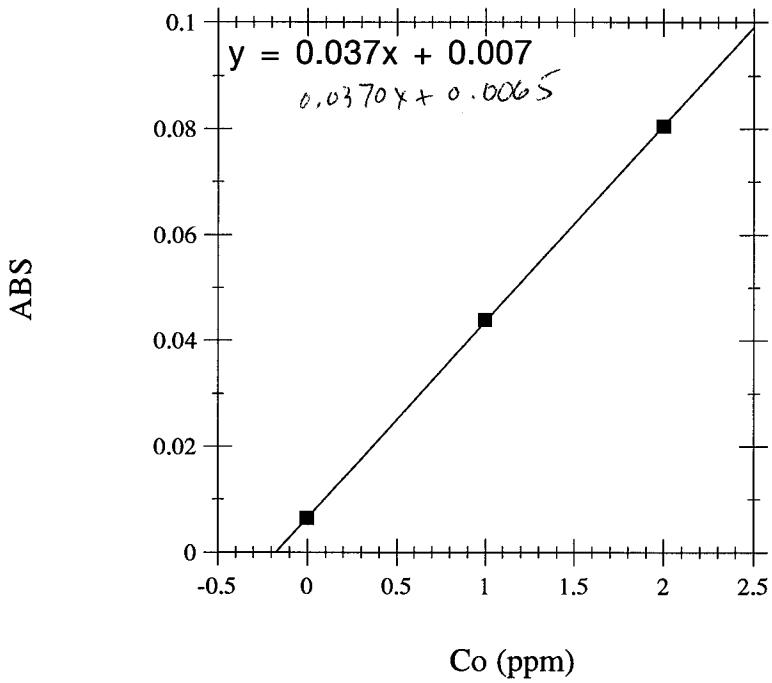
SAN-022 MgCl2




.2861 x 2 = .5722

$.5722 \times \frac{8}{1.022} = 4.479 \text{ ppm}$

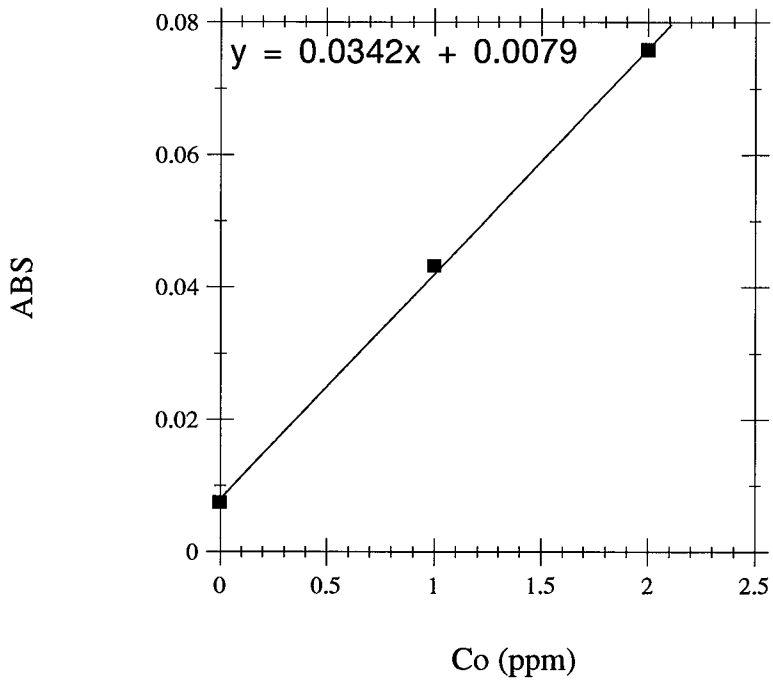
SAN-023 MgCl2




.1757 x 2 = .3514

.3514 x 8/1.022 = 2.751 ppm

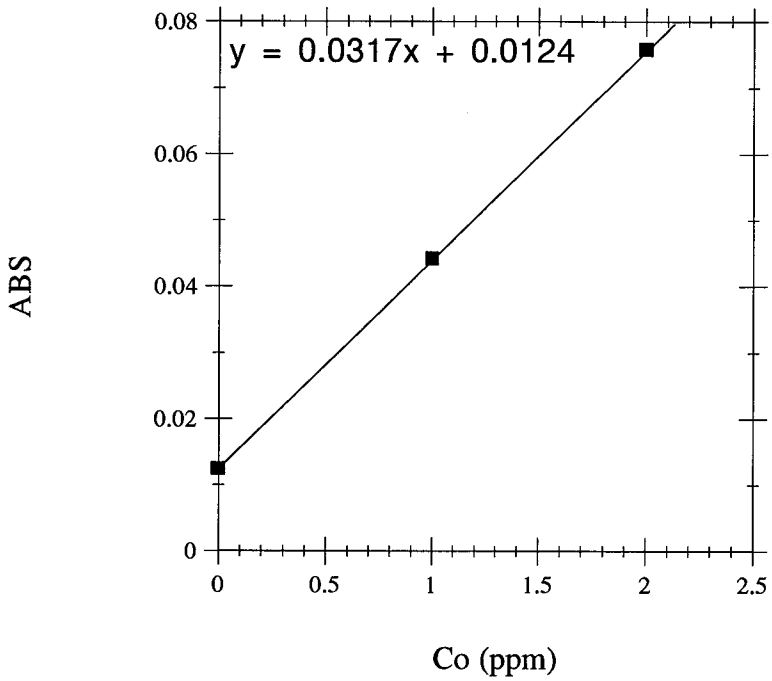
SAN-024 MgCl2



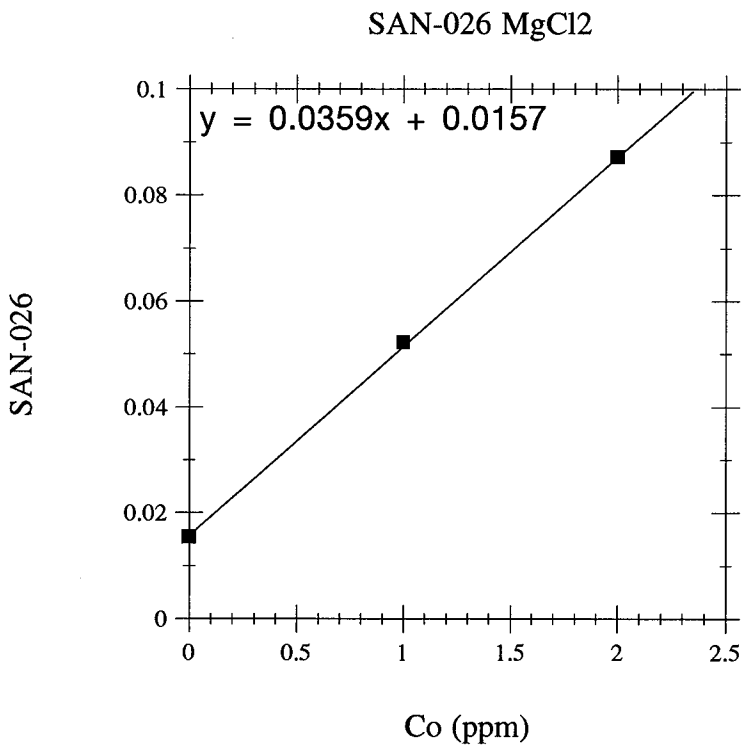

.2310 x 2 = .4620

.462 x 8/1.018 = 3.631 ppm

SAN-025 MgCl2

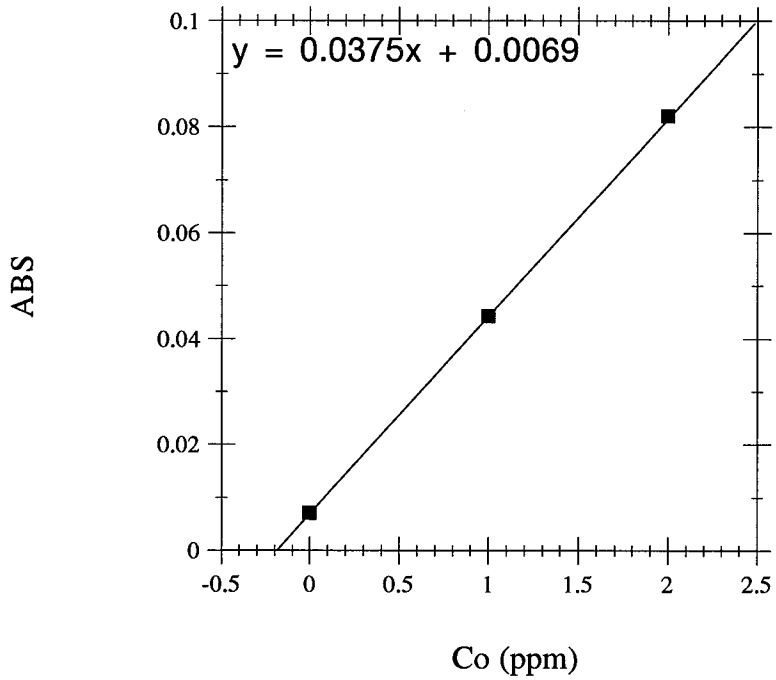



$.3912 \times 2 = .7824 \times \frac{8}{1.025} = 6.106$ ppm



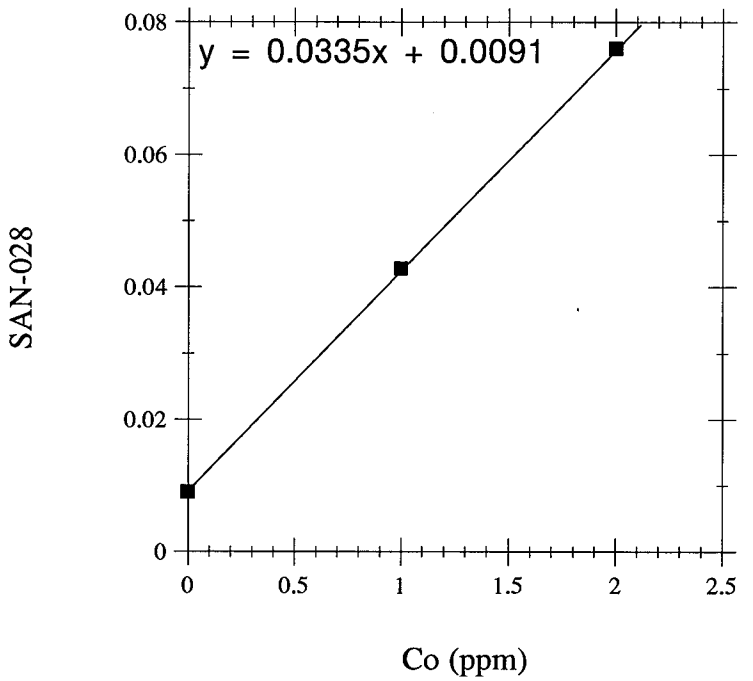

$.4373 \times 2 = .8746 \times \frac{8}{1.021} = 6.853 \text{ ppm}$

SAN-027 MgCl2



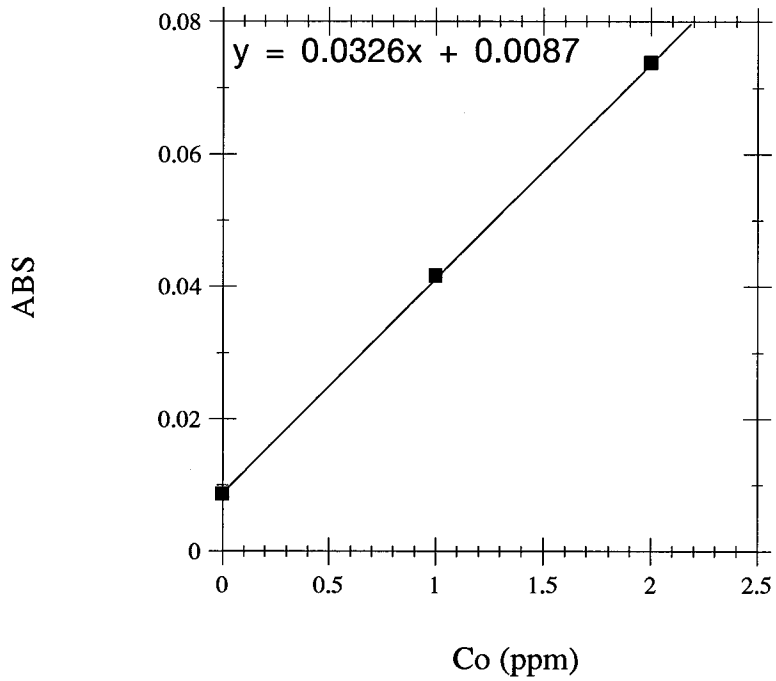

$0.184 \times 2 = .368 \times \frac{8}{1013} = 2.906$ ppm

SAN-028 MgCl2




$.2716 \times 2 = .5432 \times \frac{8}{1.023} = 4.248\text{ppm}$

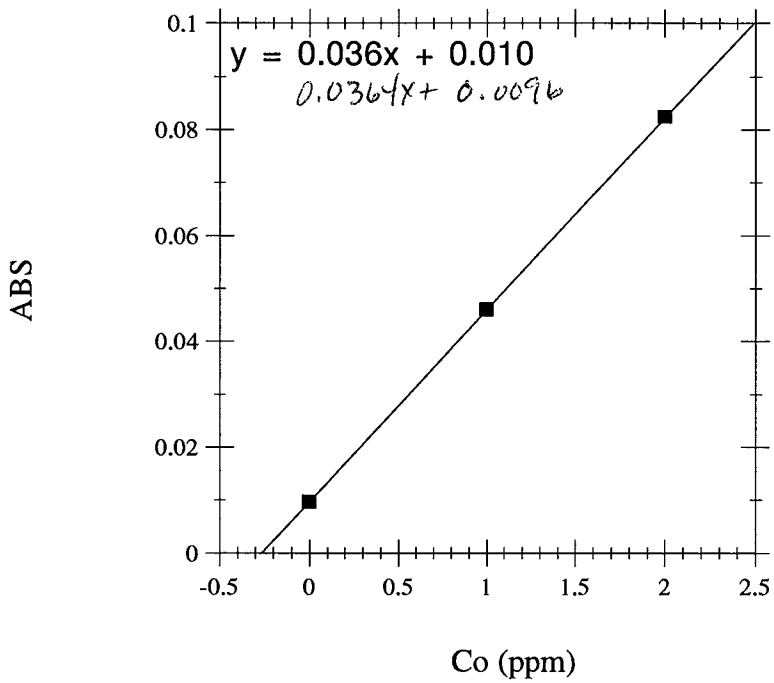
SAN-029 MgCl2




.2669 x 2 = .5338

$.5338 \times \frac{8}{1.02} = 4.187$ ppm

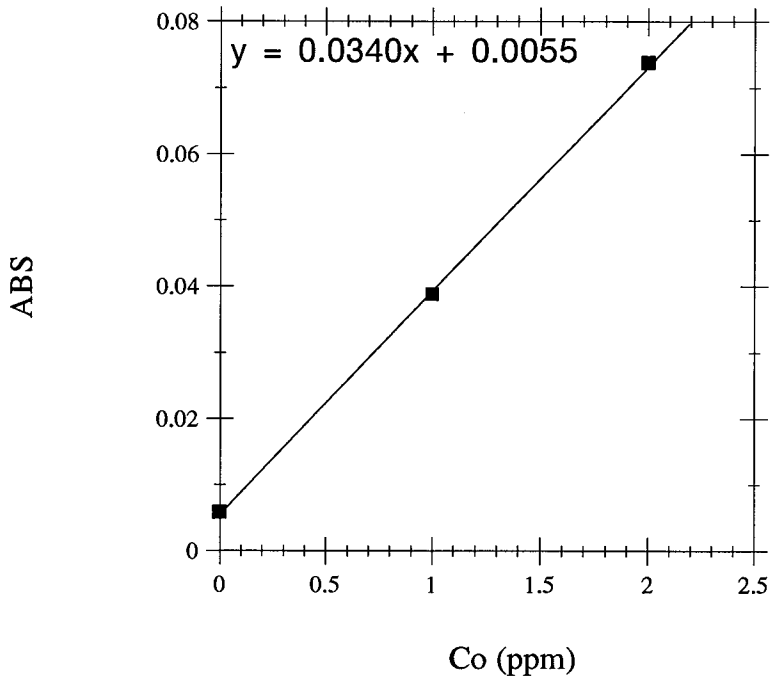
SAN-030 MgCl2




.2637 × 2 = .5274

$.5274 \times \frac{8}{1.022} = \underline{4.128 \text{ ppm}}$

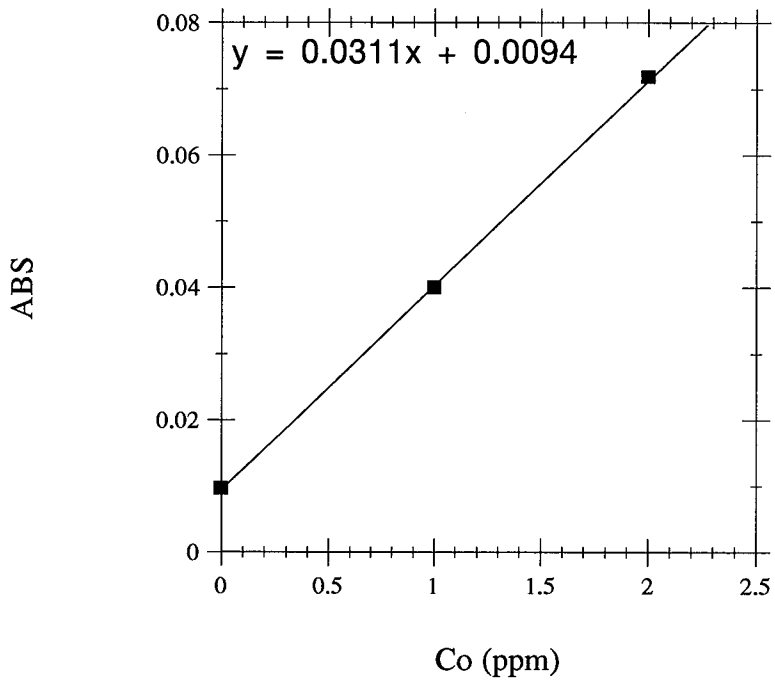
SAN-031 MgCl2




.1618 x 2 = .3236

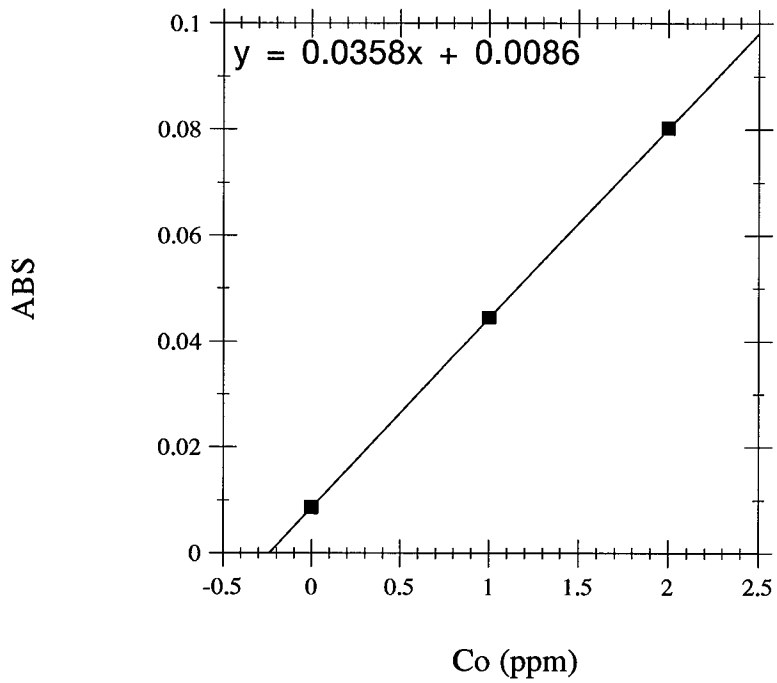
$.3236 \times \frac{8}{1.026} = 2.523$ ppm

SAN-032 MgCl2



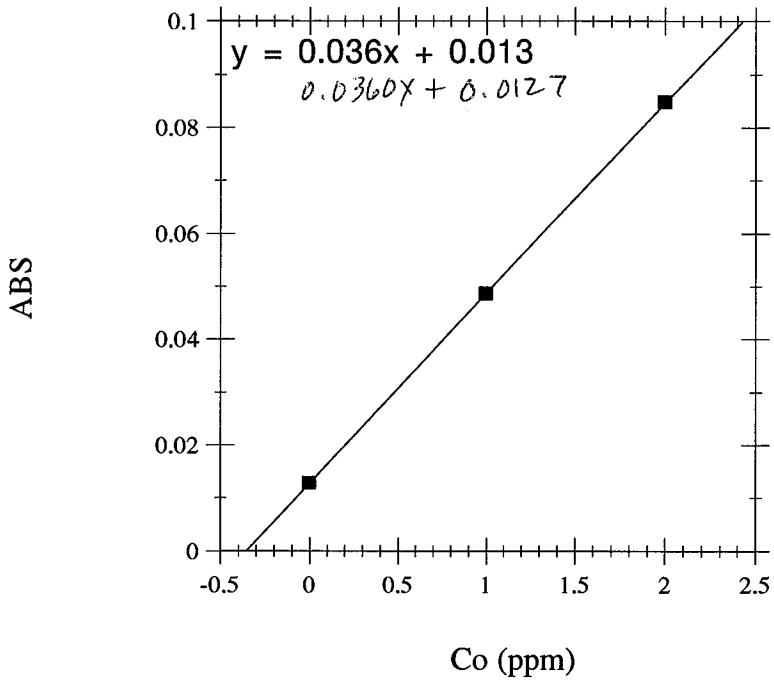

$.3022 \times 2 = .6044 \times \frac{8}{1.017} = 4.754$ ppm

SAN-033




.2402 x 2 = .4804 x 8/1.012 = 3.798 ppm

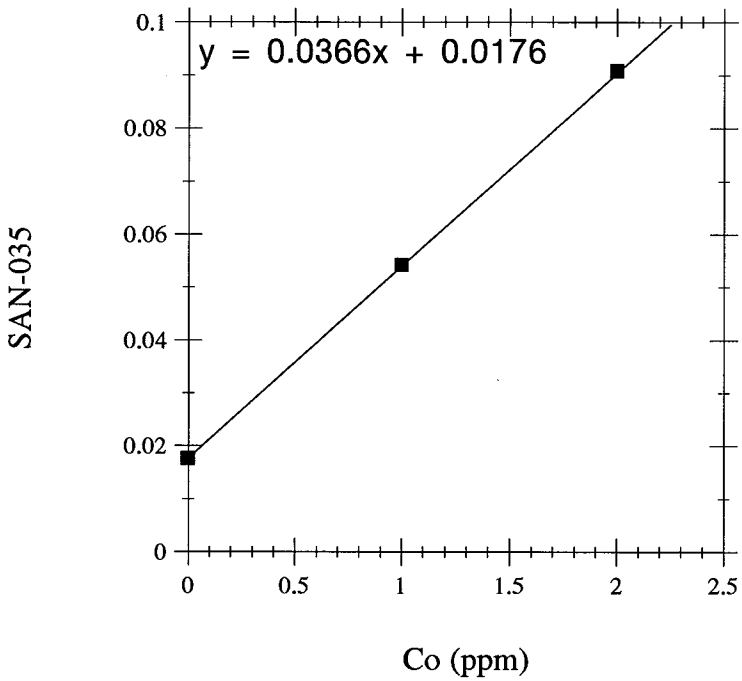
SAN-034 MgCl2




.3528 ×2

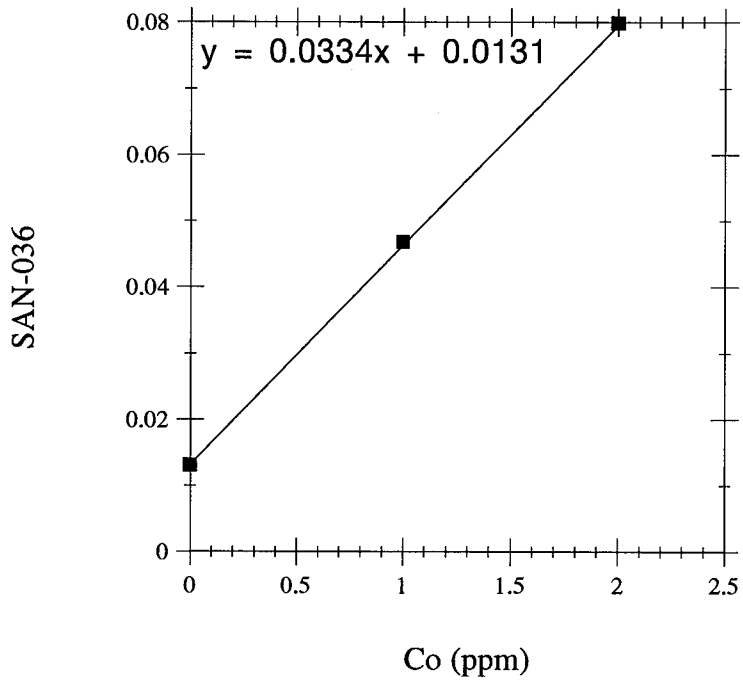
.7056 × 8/1.009 = 5.594 ppm

SAN-035 MgCl2



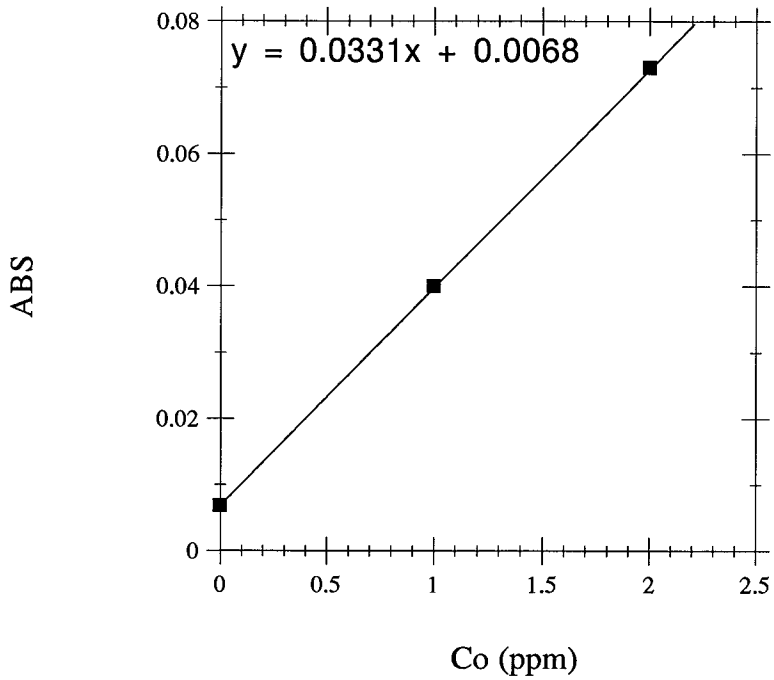

$.4809 \times 2 = .9618 \times \frac{8}{1.02} = 7.543 ppm$

SAN-036 MgCl2




.3922 x 2 = .7844 x 8/1.014 = 6.188 ppm

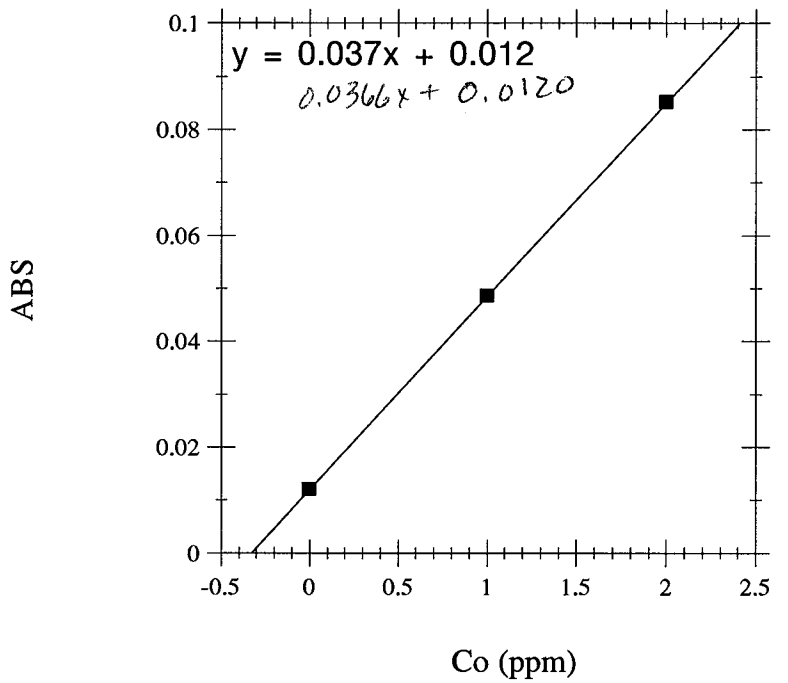
SAN-037 MgCl2




.2054 x 2 = .4108

$\frac{.4108 \times 8}{1.021} = 3.219$ ppm

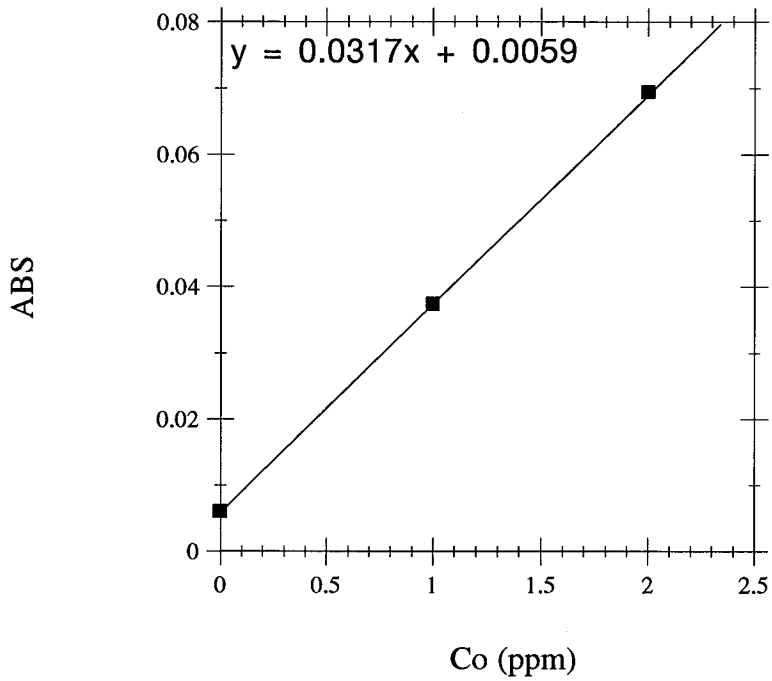
SAN-038 MgCl2




.3278 x 2 = .6556

.6556 x 8/1.024 = 5.122 ppm

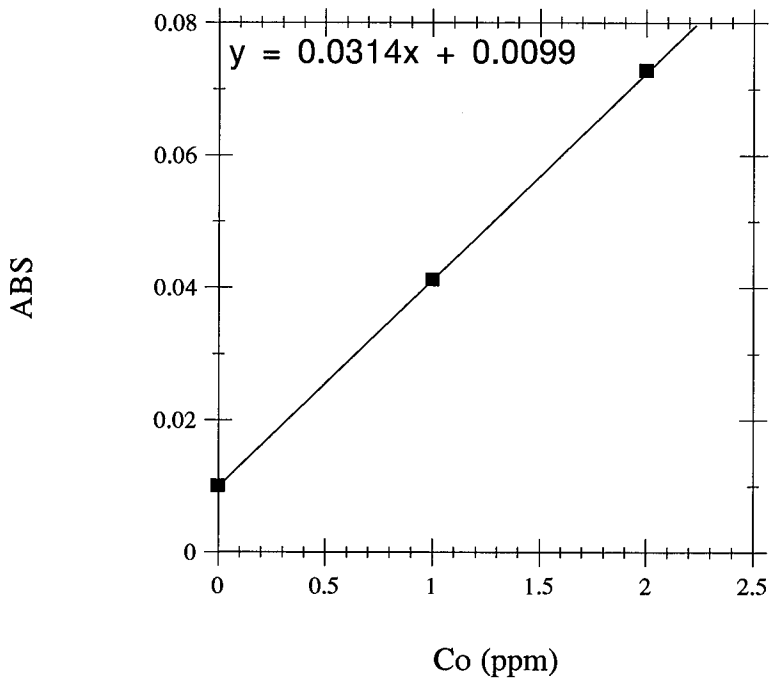
SAN-039 MgCl2




.1861 x2 = .3722

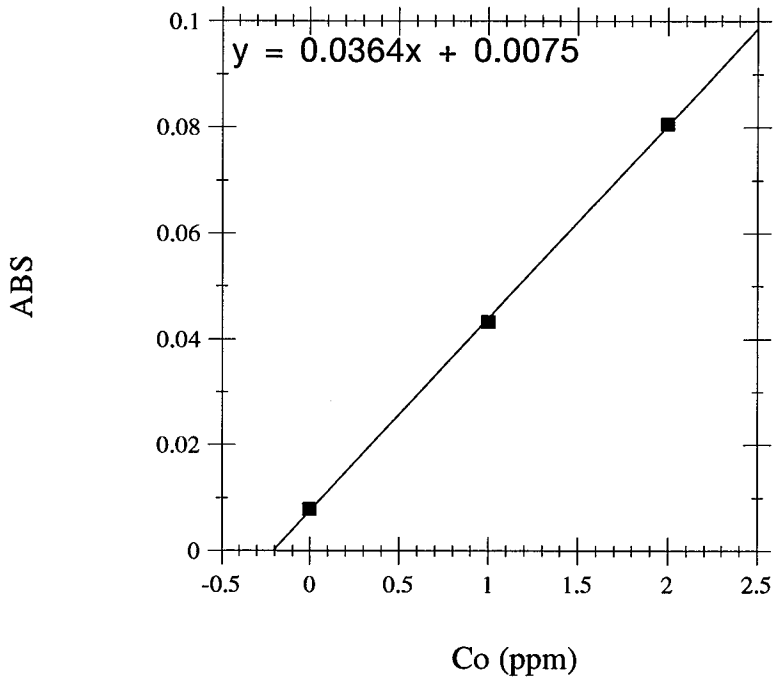
$\frac{.3722 + 8}{1.018} = 2.925$ ppm

SAN-040 MgCl2



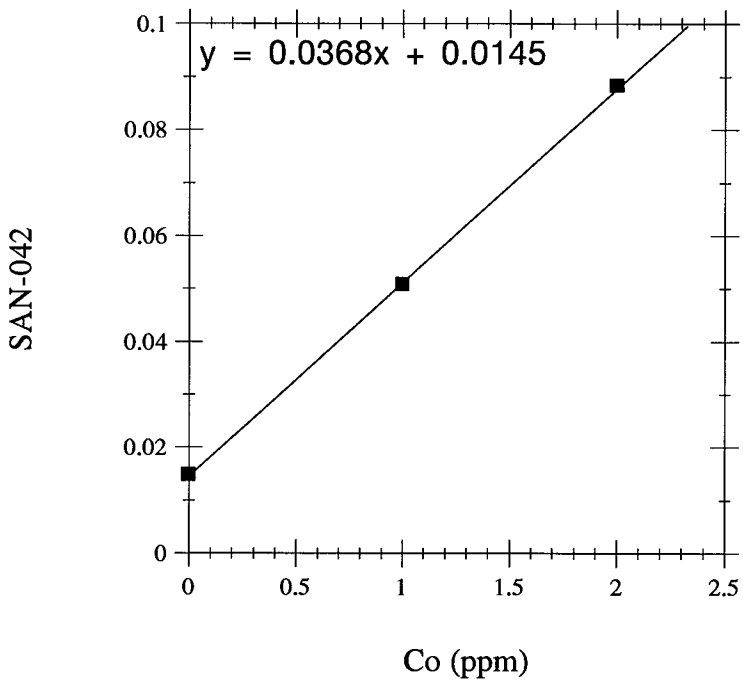

$.3153 \times 2 = \cancel{.60}\ .6306 \times \frac{8}{1.017} = 4.960\ ppm$

SAN-041 MgCl2



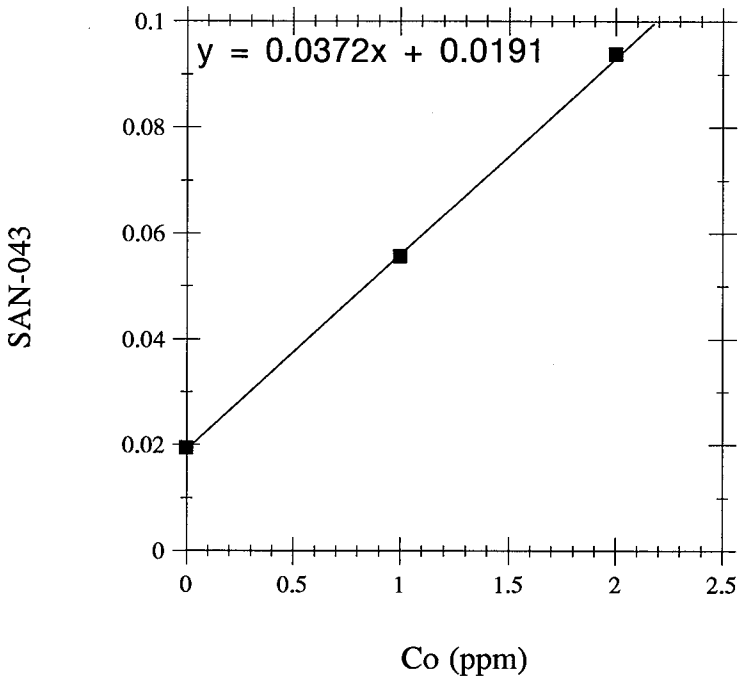

$.206 \times 2 = .412 \times \frac{8}{1.015} = 3.247$ ppm

SAN-042 MgCl2



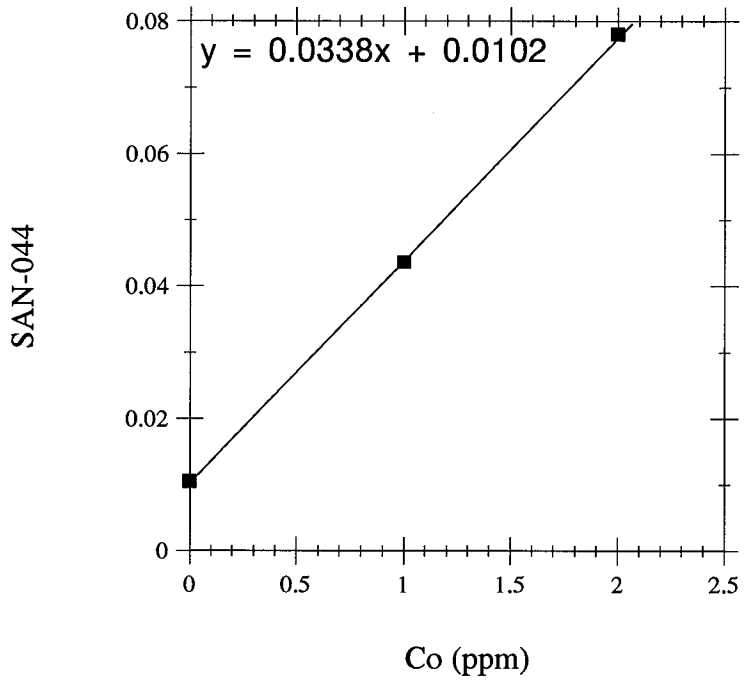

.3940 x2 = .788 x 8/1.012 = 6.23 ppm

SAN-043 MgCl2



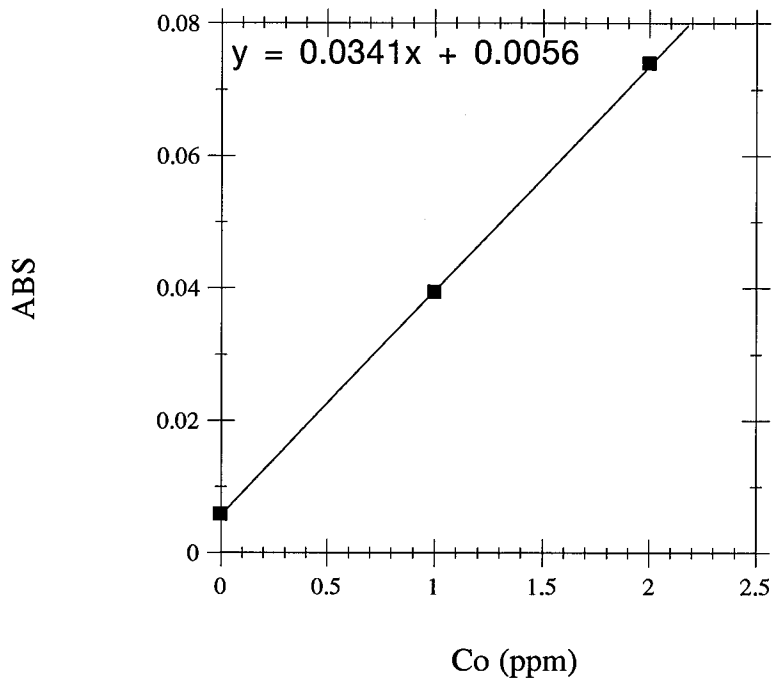

$.5134 \times 2 = 1.0268 \times \frac{8}{1.022} = 8.038\ ppm$

SAN-044 MgCl2




$.3018 \times 2 = .6036 \times \frac{8}{1.014} = 4.762$ ppm

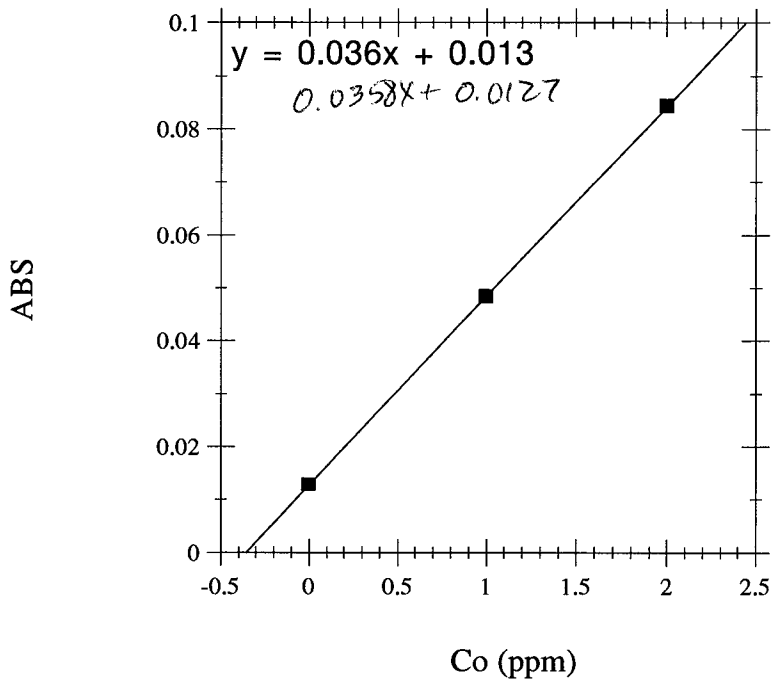
SAN-045 MgCl2




.1642 x 2 = .3284

$\frac{.3284 \times 8}{1.017} = 2.583$ ppm

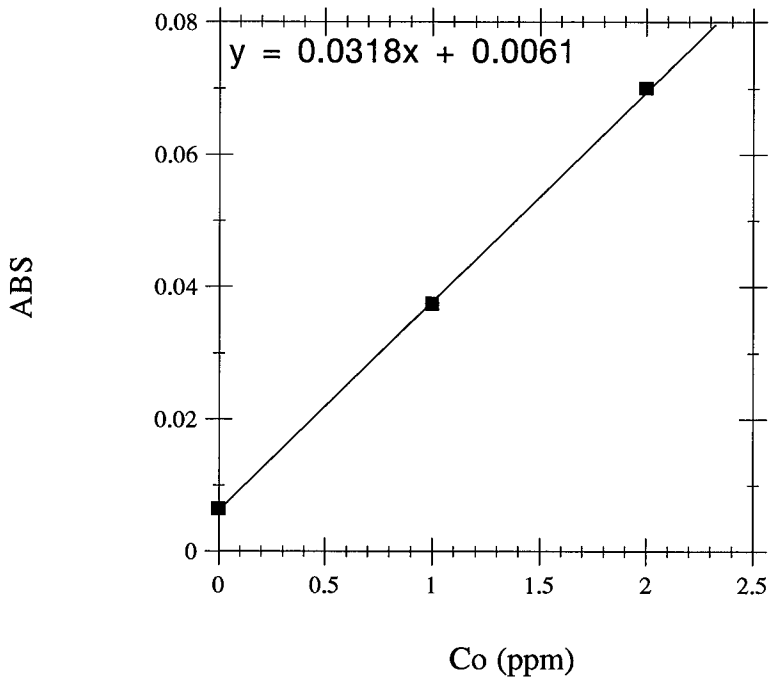
SAN-046 MgCl2




.3547 x2 = .7094

.7094 x 8 / 1.022 = 5.553 ppm

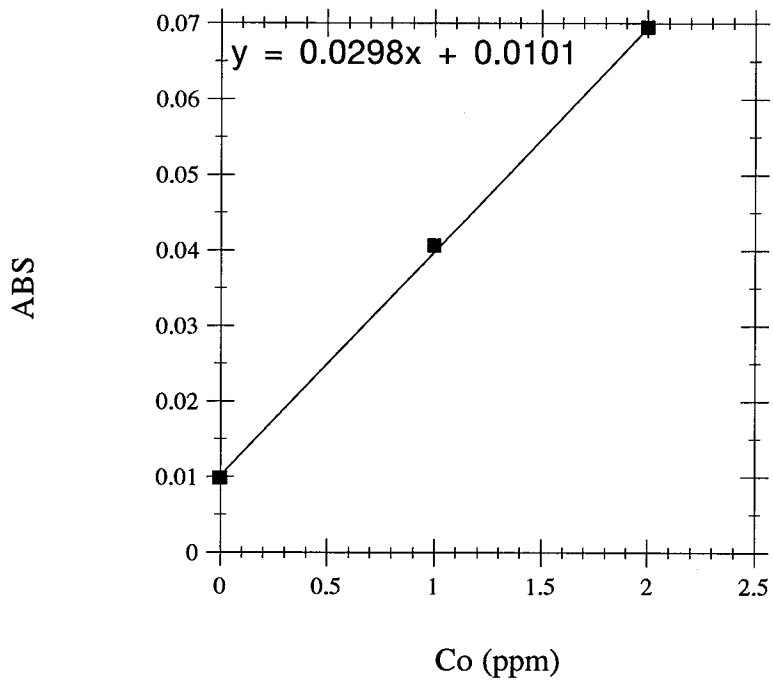
SAN-047 MgCl2




.1918 x 2 = .3836

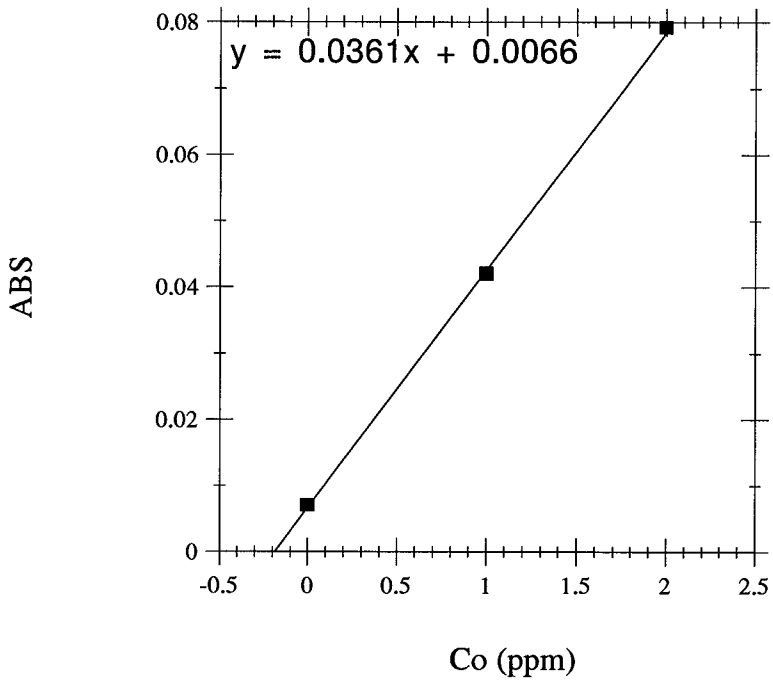
$.3836 \times \frac{8}{1.023} = 2.999$ ppm

SAN-048 MgCl2



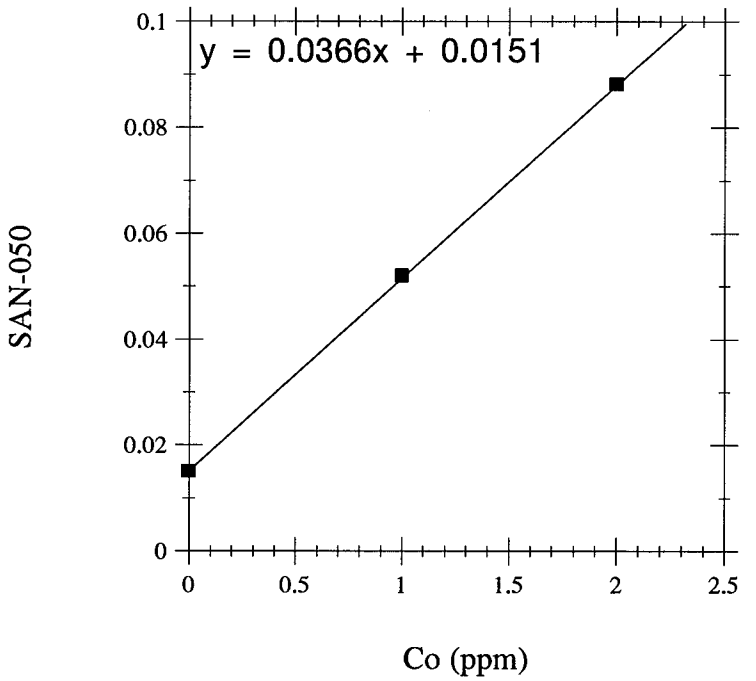

~~.38~~ .3389 x 2 = .6778 x 8 / 1.022 = 5.306 ppm

SAN-049 MgCl2



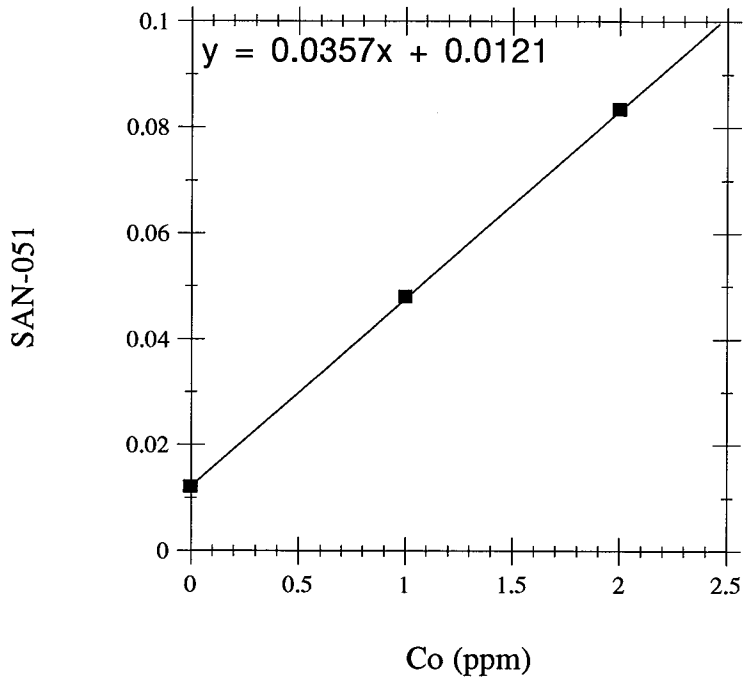

$.1828 \times 2 = .3656 \times \frac{8}{1.017} = 2.876$ ppm

SAN-050 MgCl2

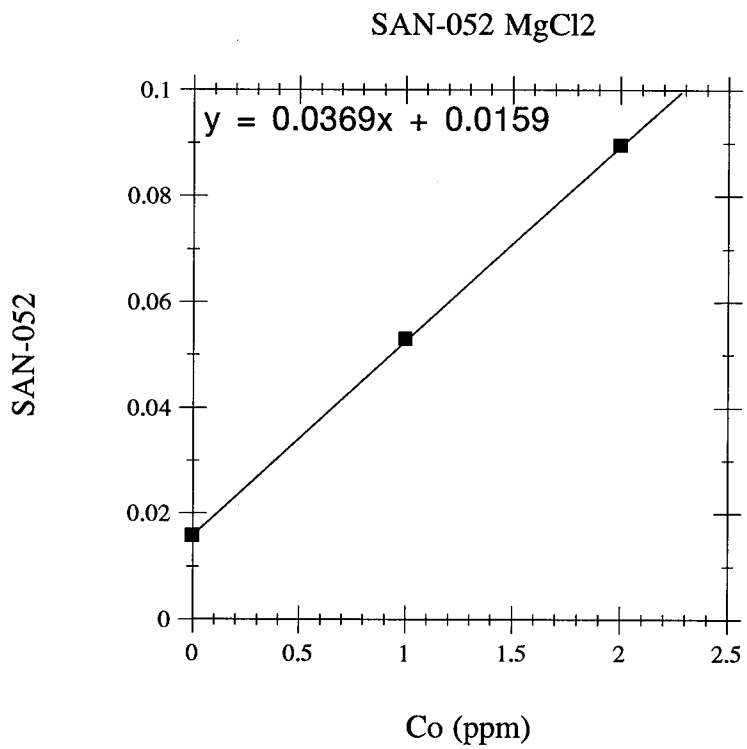



$.4126 \times 2 = .8252 \times \frac{8}{1.016} = 6.498$ ppm

SAN-051 MgCl2

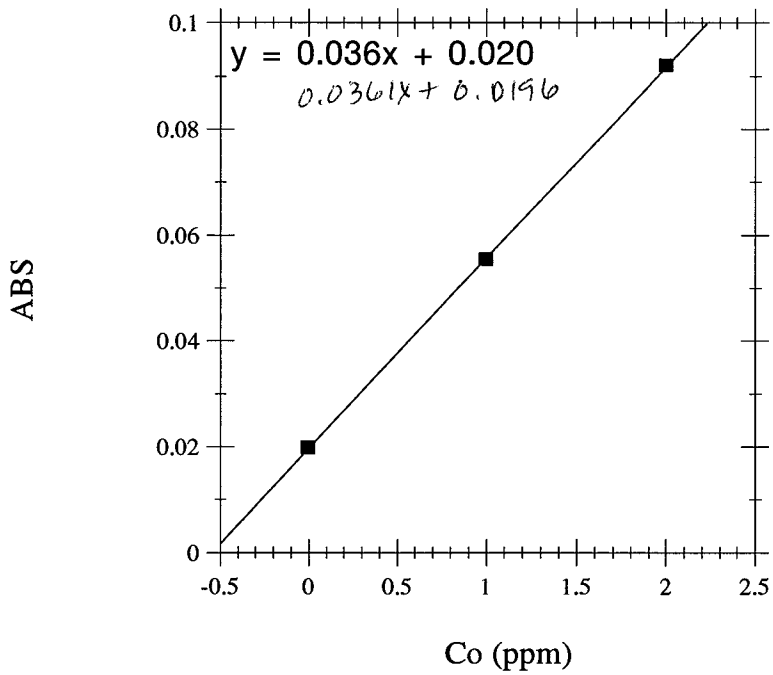



$.3389 \times 2 = .6778 \times \frac{8}{1.017} = 5.332$ ppm




$.4309 \times 2 = .8618 \times \frac{8}{1.02} = 6.759$ ppm

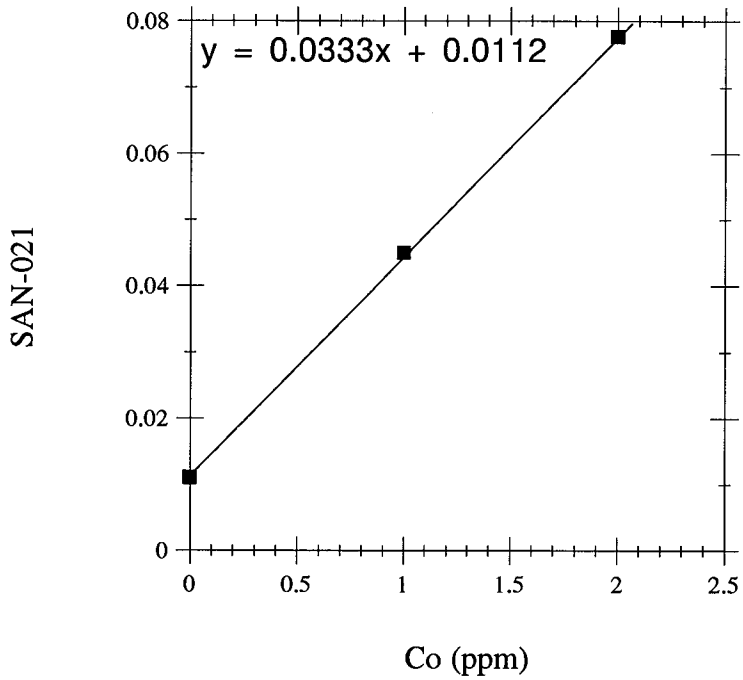
SAN-053 MgCl2




.5429 × 2 = 1.0858

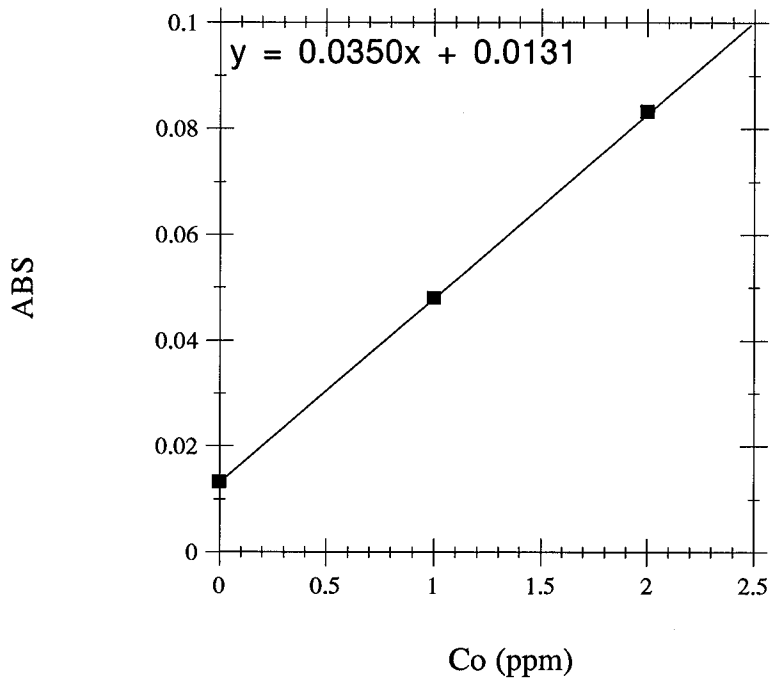
1.0858 × 8 / 1.008 = 8.617 ppm

SAN-021 NaOAc




.3363 x 2 = .6726 x 8/1.016 = 5.296 ppm

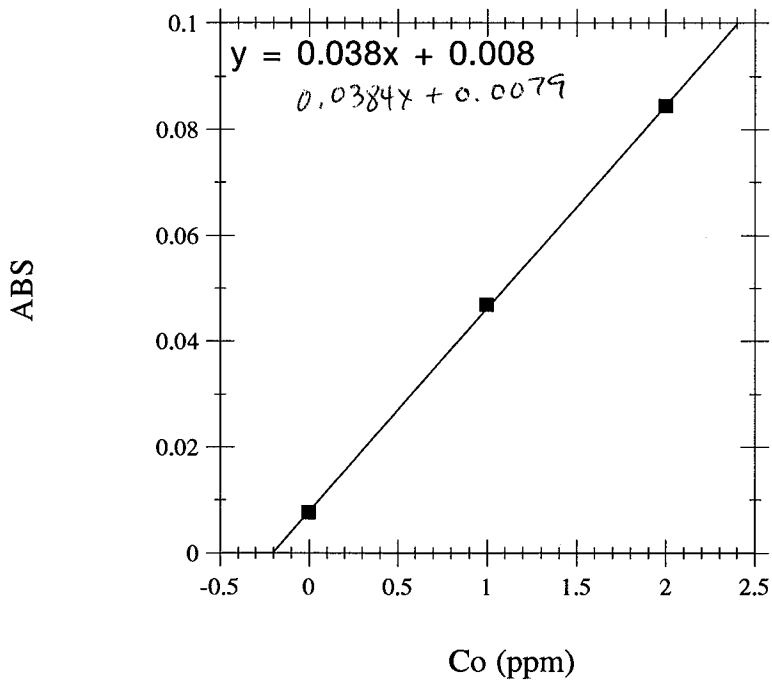
SAN-022 NaOAc




.3743 x 2 = .7486

$.7486 \times \frac{8}{1.022} = \underline{5.860 \text{ ppm}}$

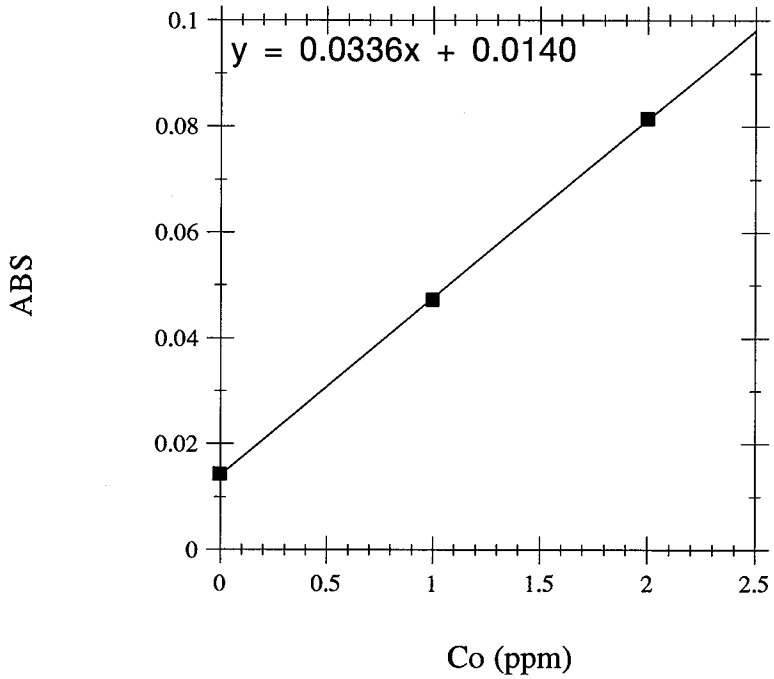
SAN-023 NaOAc




.2057 x2 = .4114

$.4114 \times \frac{8}{1.022} = 3.22$ ppm

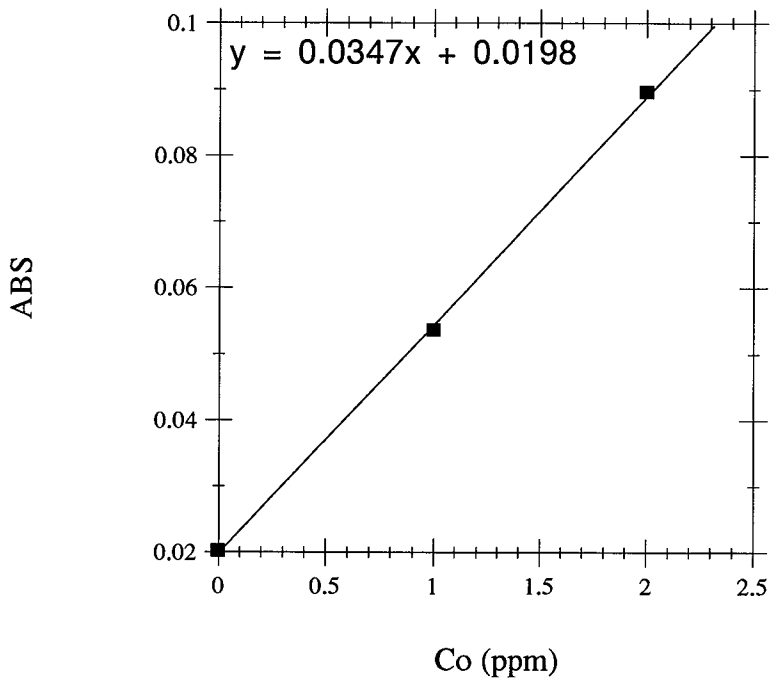
SAN-024 NaOAc




.4167 x 2 = .8334

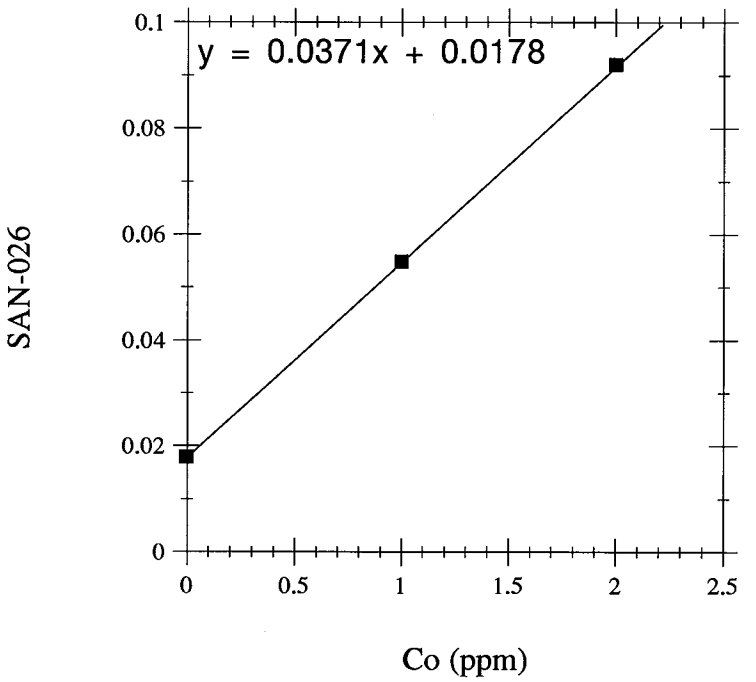
$\frac{.8334 \times 8}{1.018} = 6.549$ ppm

SAN-025 NaOAc



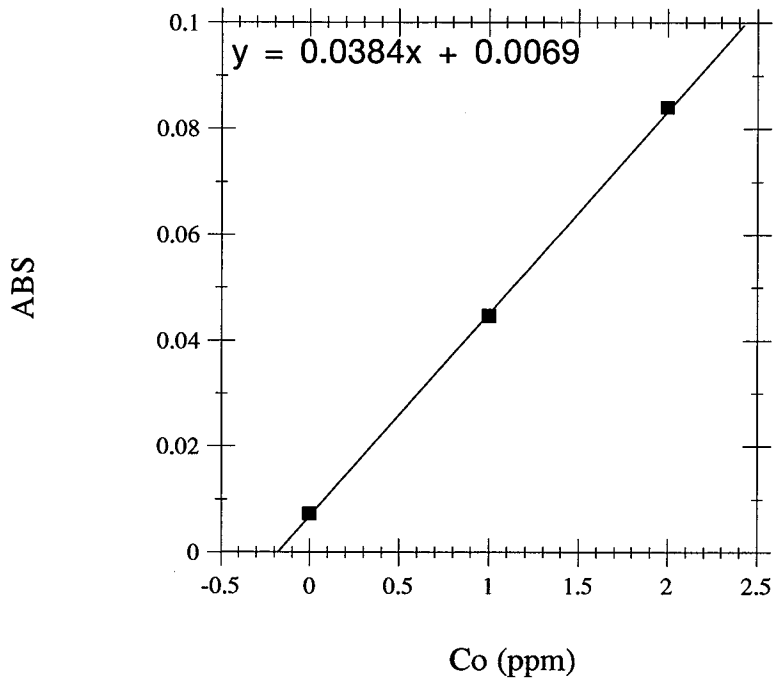

$.5706 \times 2 = 1.1412 \times \frac{8}{1.025} = 8.907$ ppm.

SAN-026 NaOAc



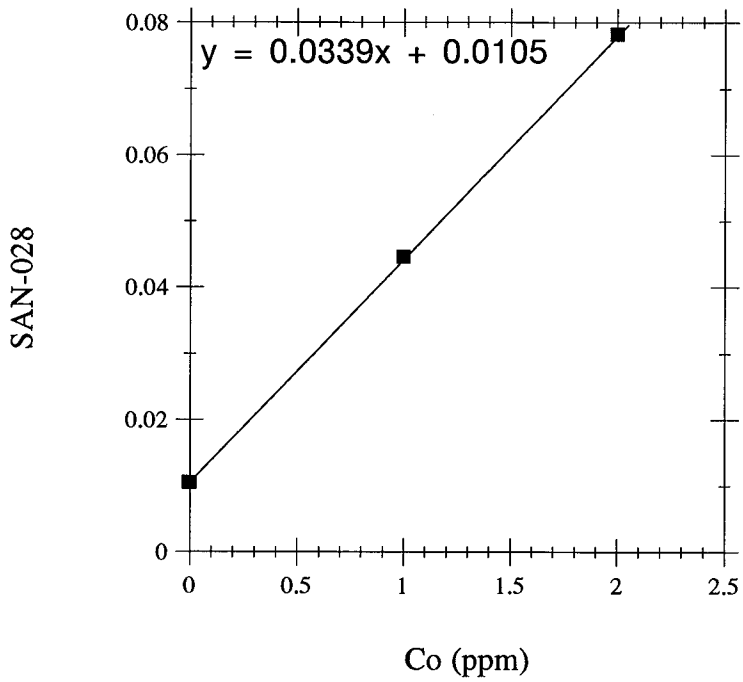

.4798x2 = .9596 x 8/1.021 = 7.519ppm

SAN-027 NaOAc



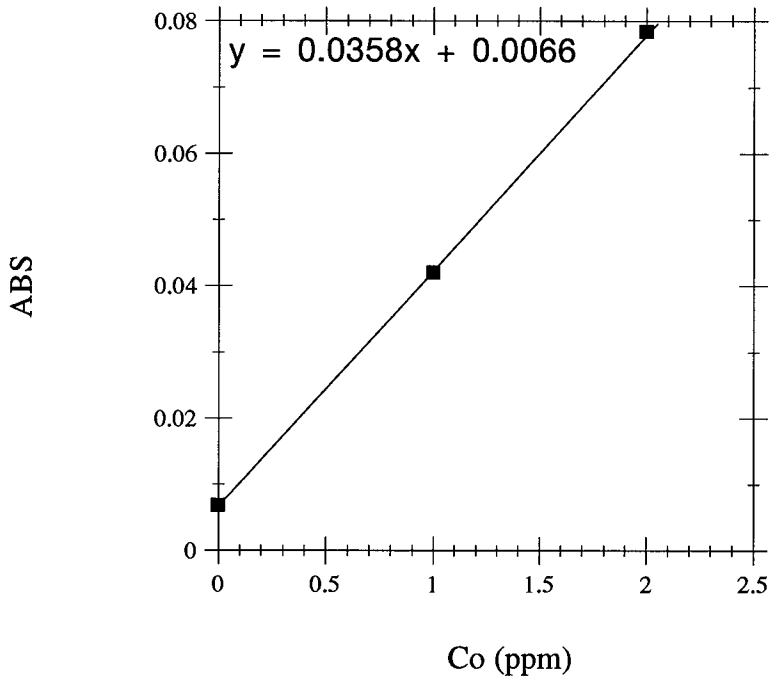

$.1797 \times 2 = .3594 \times \frac{8}{1.013} = \underline{2.838 \text{ ppm}}$

SAN-028 NaOAc




.3097x2= .6194 x 8/1.023 = 4.844ppm

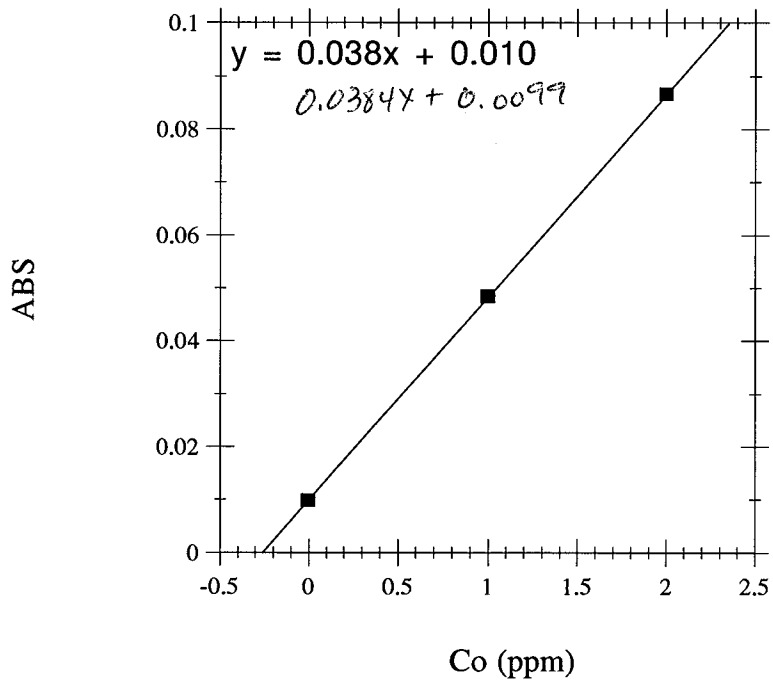
SAN-029 NaOAc




.1844 x 2 = .3688

$\frac{.3688 \times 8}{1.02} = 2.892$ ppm

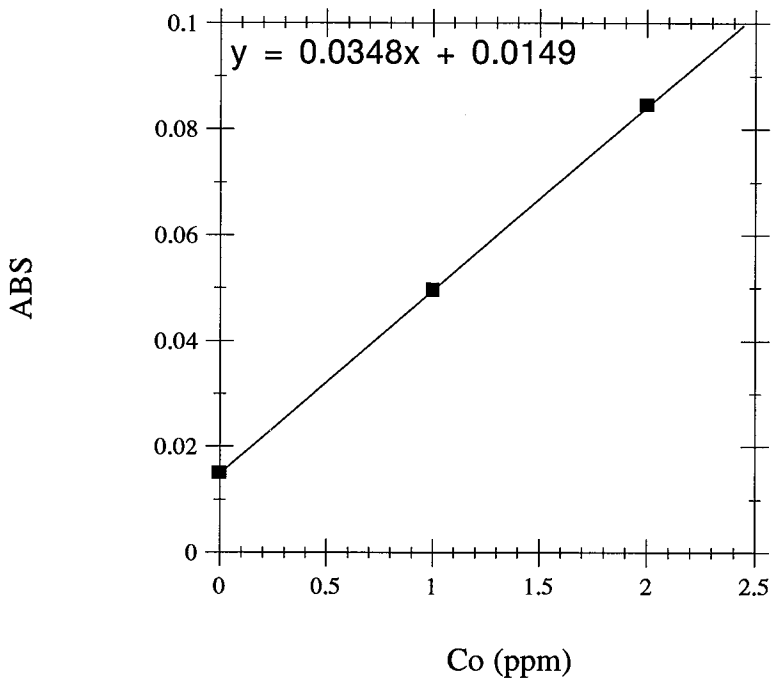
SAN-030 NaOAc




.2578 x 2 = .5156

$.5156 \times \frac{8}{1.022} = 4.036$ ppm

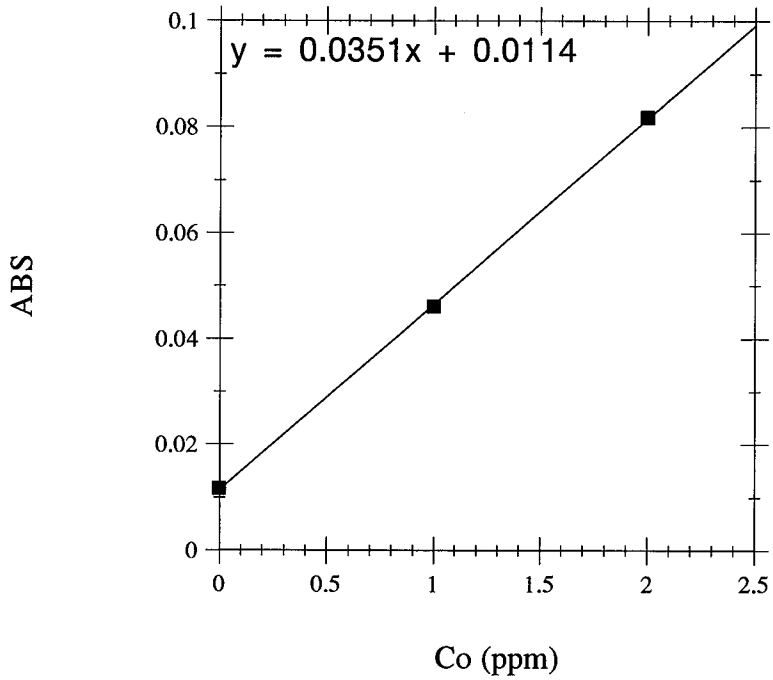
SAN-031 NaOAc




.4282 x 2 = .8564

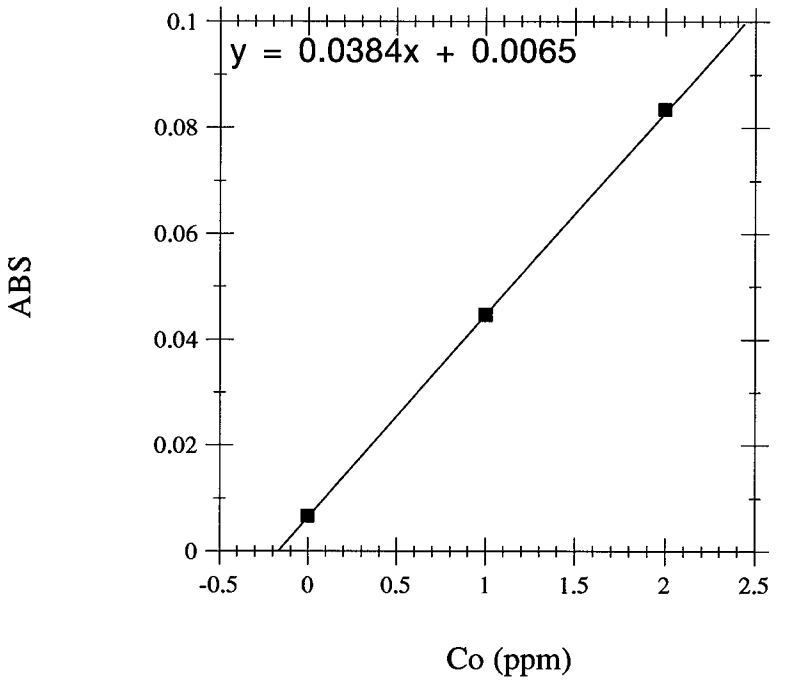
.8564 x 8/1.026 = 6.677 ppm

SAN-032 NaOAc



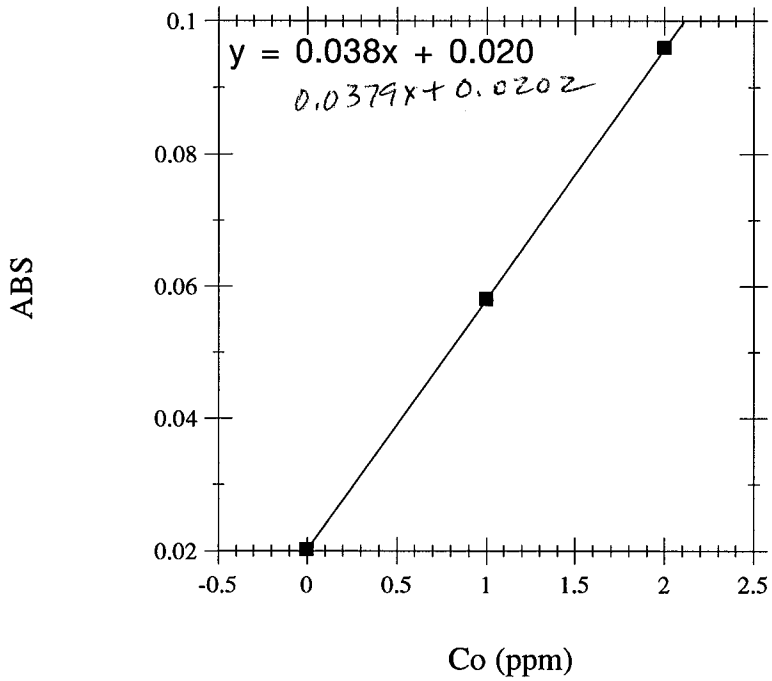

$.3248 \times 2 = .6496 \times \frac{8}{1.017} = \cancel{5.10}\ \underline{5.11\ ppm}$

SAN-033 NaOAc




$.1693 \times 2 = .3386 \times \frac{8}{1.012} = \underline{2.677 \text{ ppm}}$

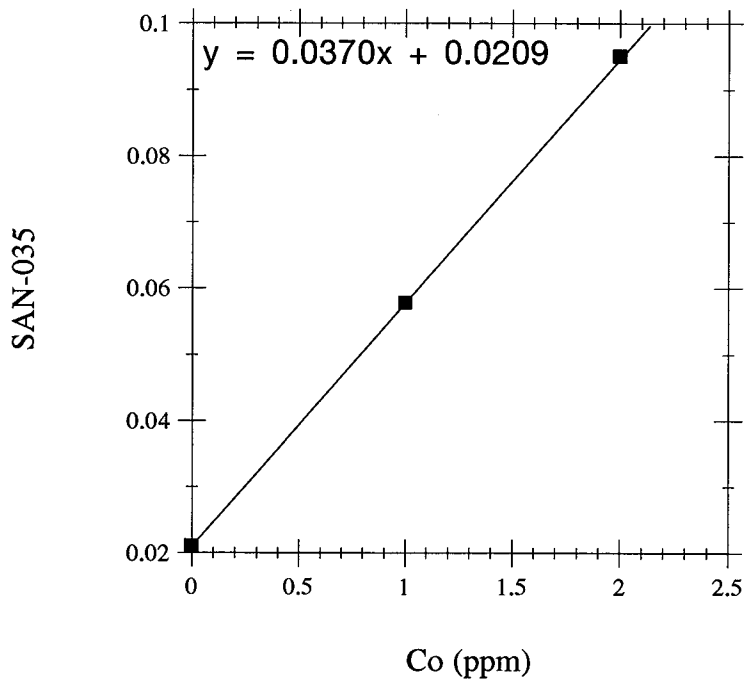
SAN-034 NaOAc



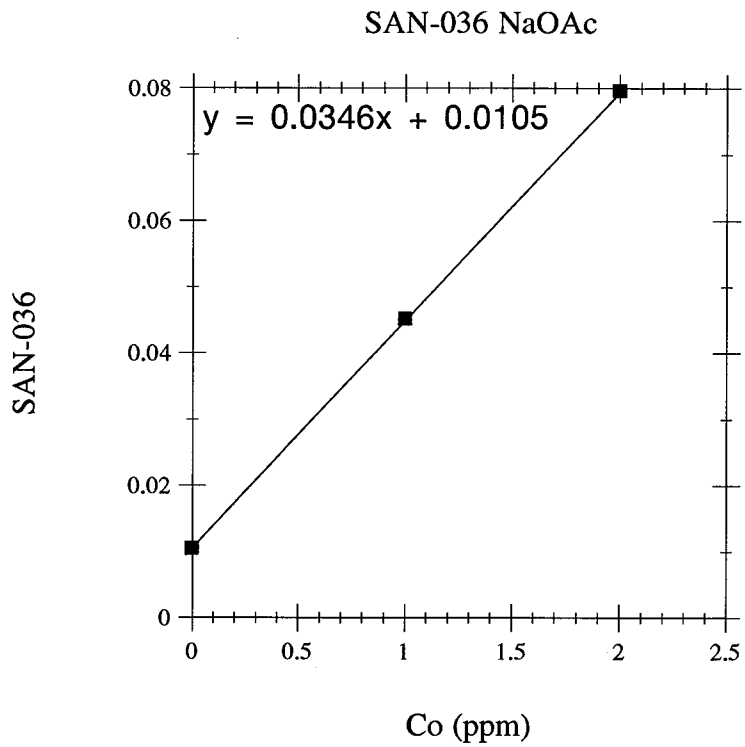

.533 x2 = 1.066

$1.066 \times \frac{8}{1.009} = 8.452$ ppm

SAN-035 NaOAc

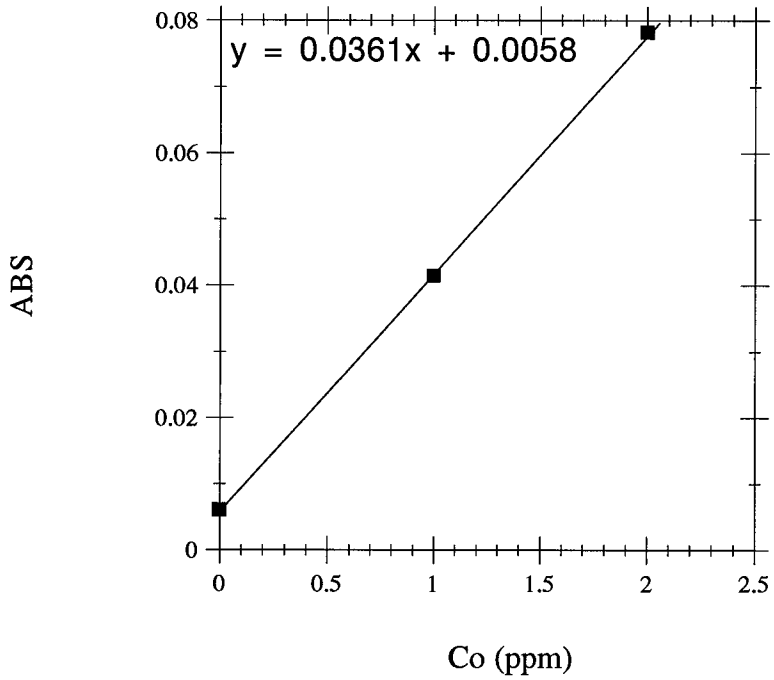



$.5649 \times 2 = 1.1298 \times \frac{8}{1.02} = 8.861$ ppm




$.3035 \times 2 = \frac{.607 \times 8}{1.014} = \cancel{4.80}\ 4.789$ ppm

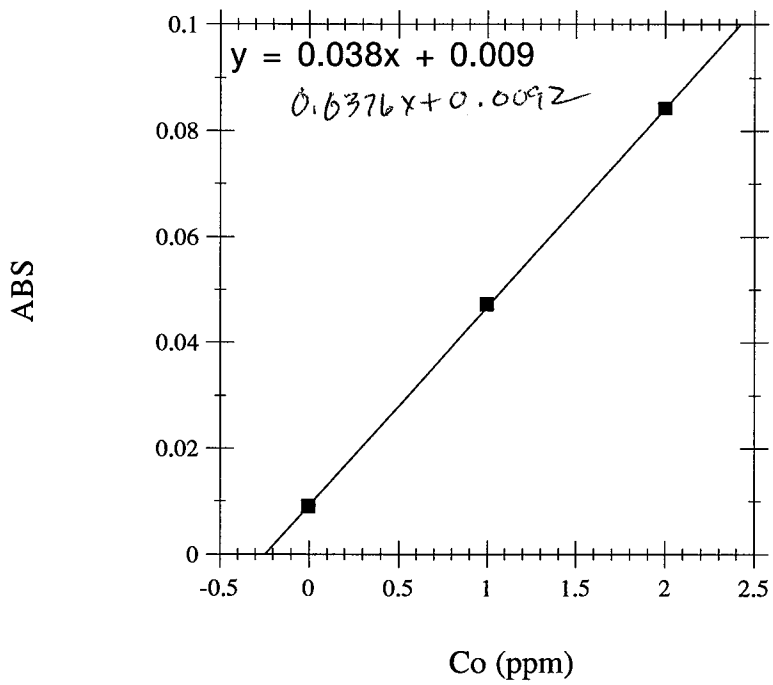
SAN-037 NaOAc




.1607 x 2 = .3214

$.3214 \times \frac{8}{1.021} = 2.518$ ppm

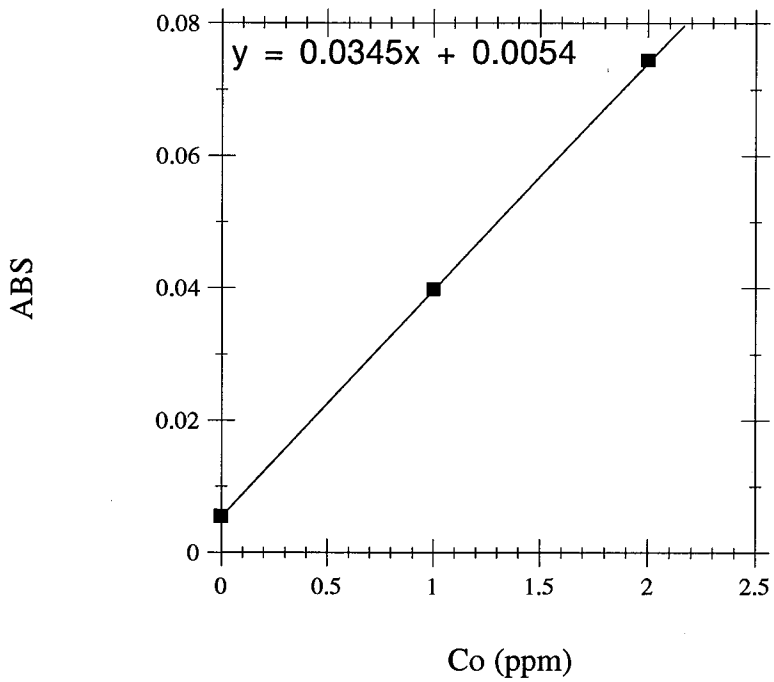
SAN-038 NaOAc




.2447 × 2 = .4894

$.4894 \times \frac{8}{1.024} = 3.823 ppm$

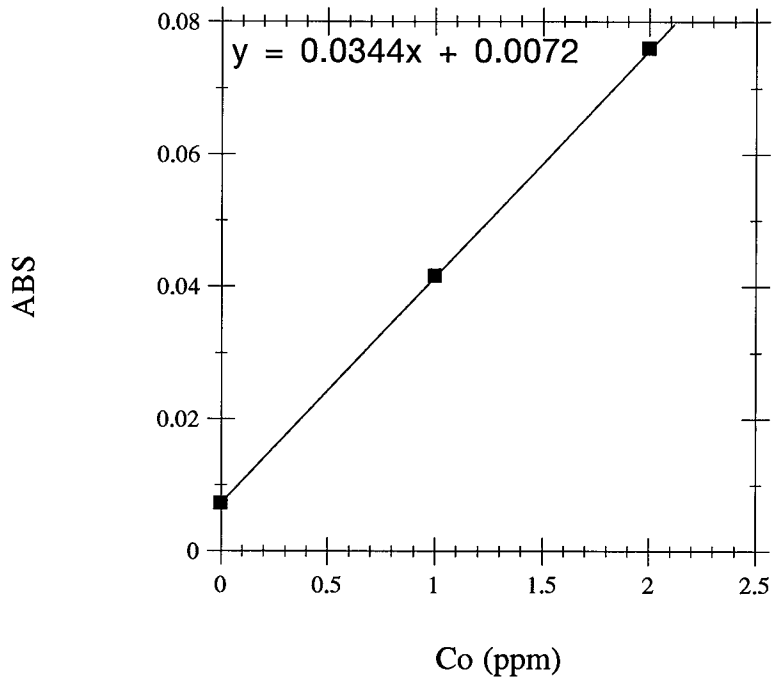
SAN-039 NaOAc




.1565 x 2 = .313

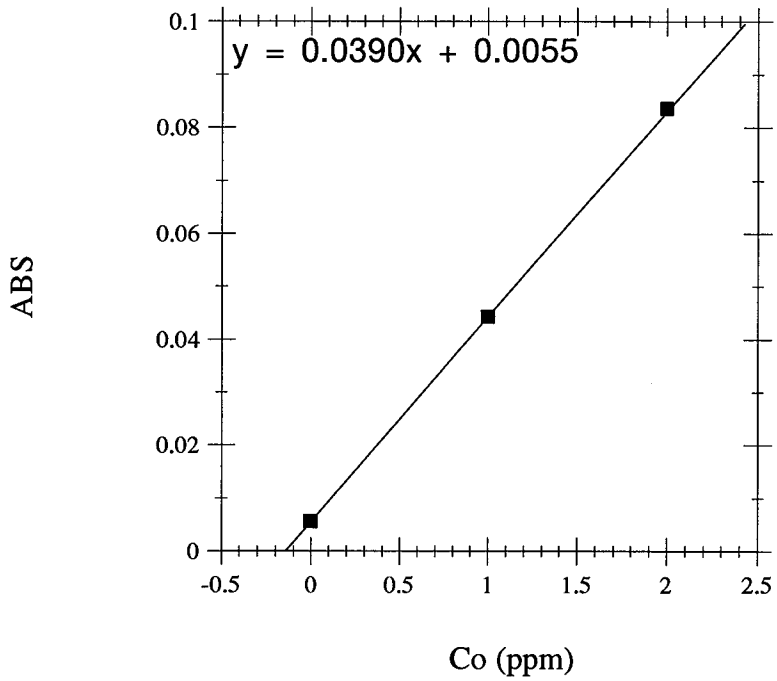
$.313 \times \frac{8}{1.018} = \underline{2.460 \text{ ppm}}$

SAN-040 NaOAc



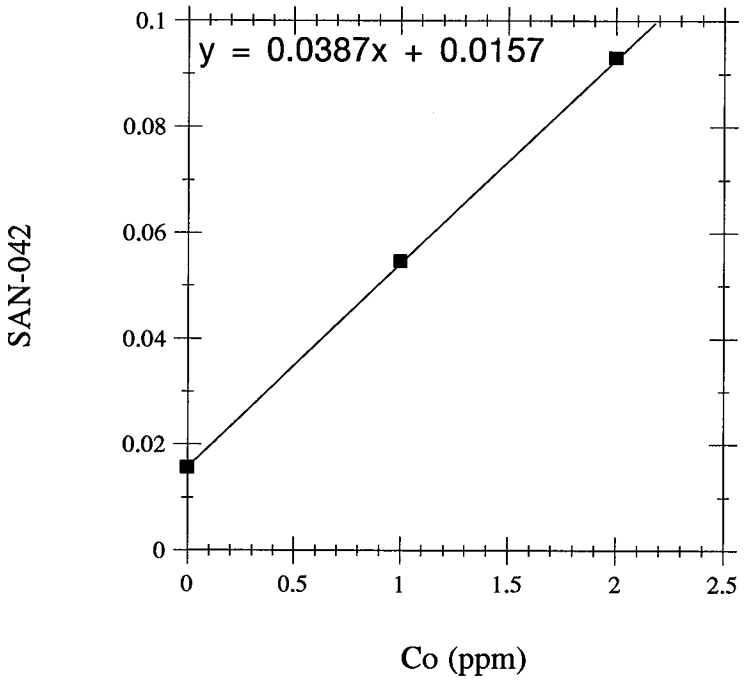

$.2093 \times 2 = .4186 \times \frac{8}{1.017} = 3.293\ ppm$

SAN-041 NaOAc



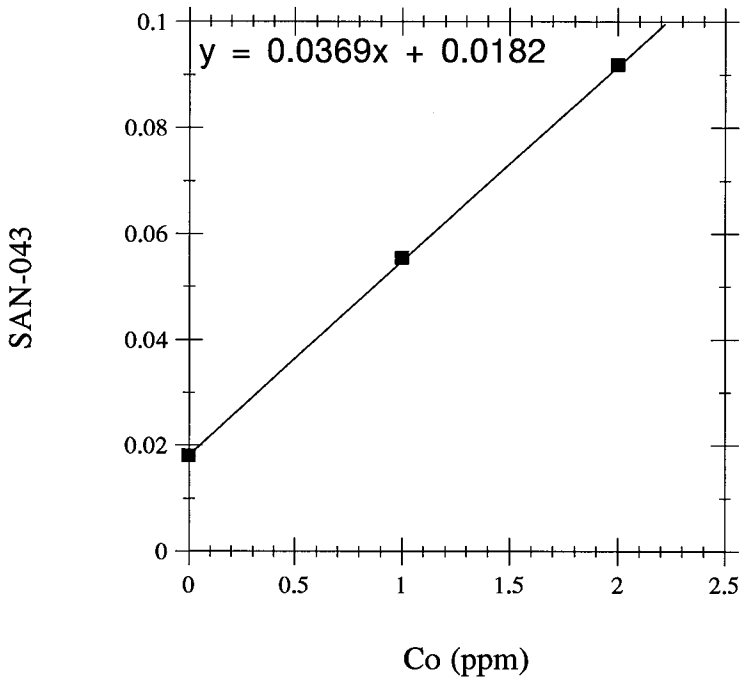

$.141 \times 2 = .282 \times \frac{8}{1.015} = \underline{2.223 \text{ ppm}}$

SAN-042 NaOAc



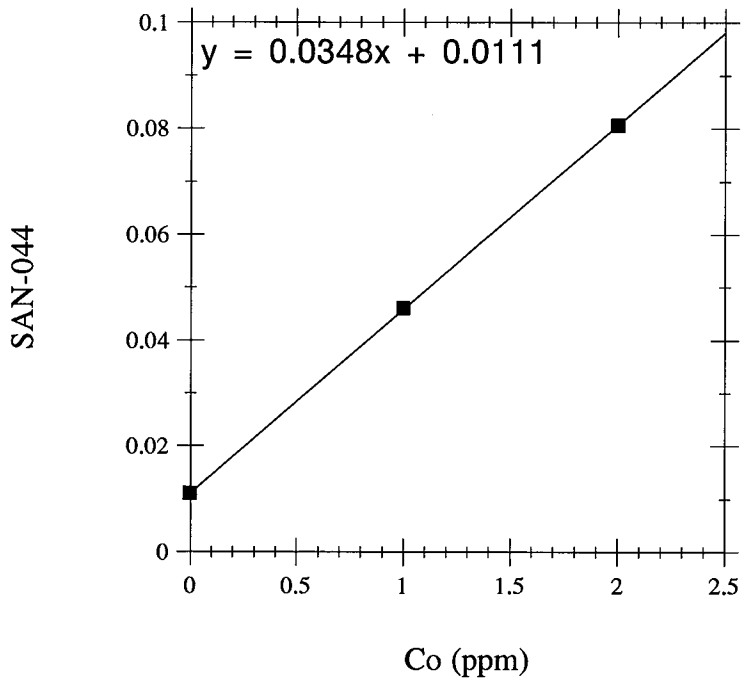

$.4057 \times 2 = .8114 \times \frac{8}{1.012} = 6.414$ ppm

SAN-043 NaOAc



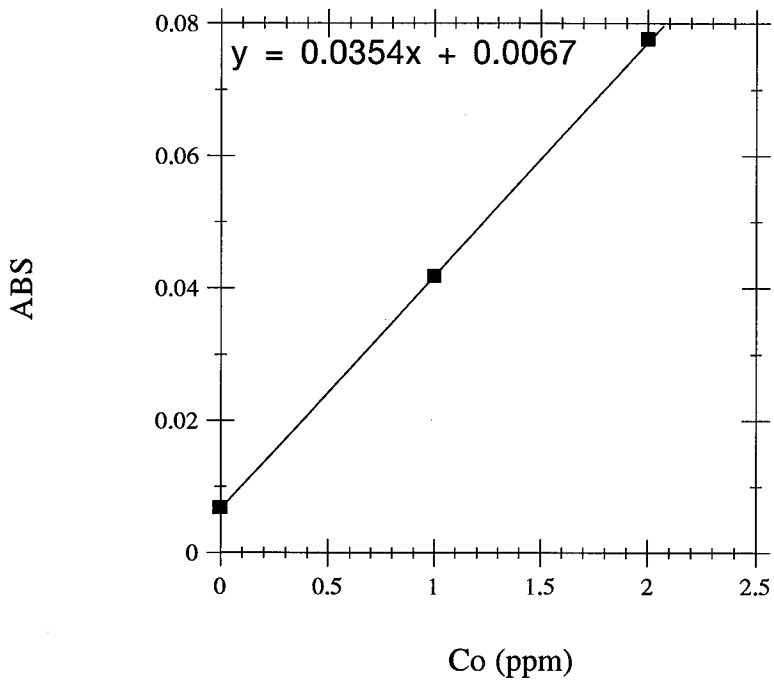

$.4932 \times 2 = .9864 \times \frac{8}{1.022} = 7.721 ppm$

SAN-044 NaOAc




~~.3189~~
.3190 x 2 = .638 x 8 / 1.014 = 5.033ppm

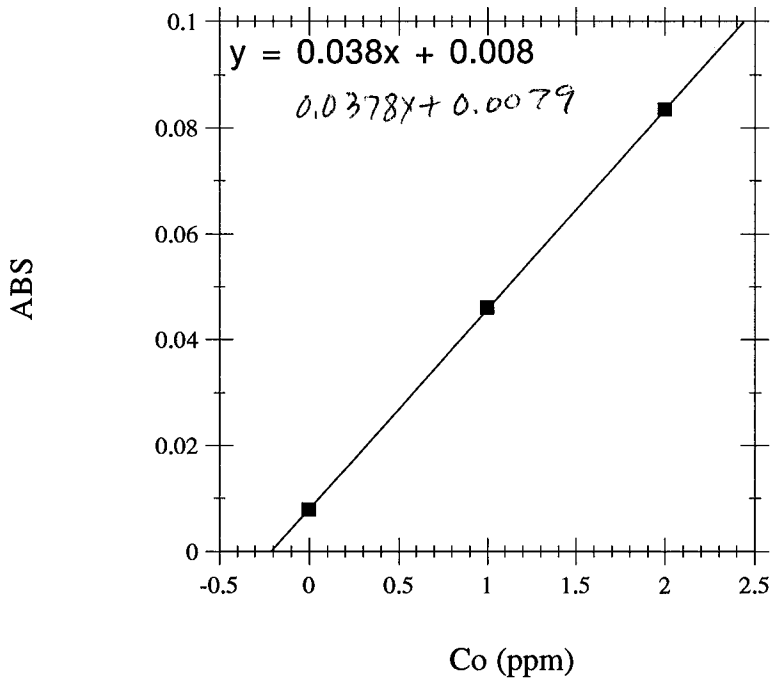
SAN-045 NaOAc




.1893 x 2 = .3786

$.3786 \times \frac{8}{1.017} = 2.978$ ppm

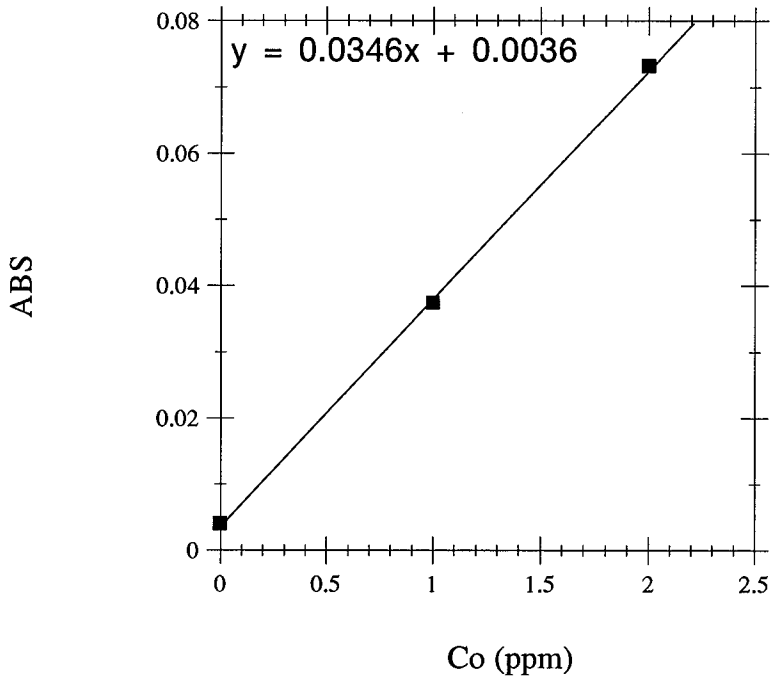
SAN-046 NaOAc




.209 x2 = .418

$.418 \times \frac{8}{1.022} = 3.272$ ppm

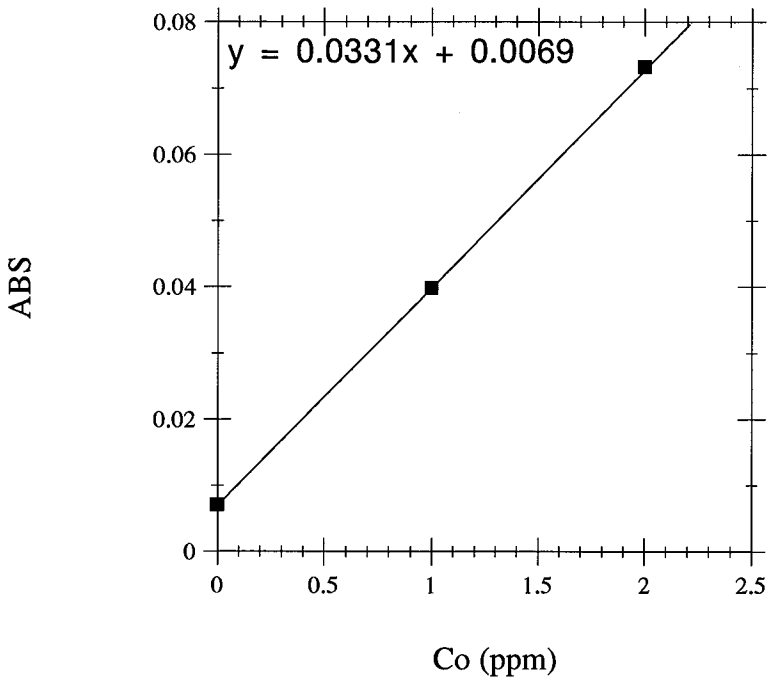
SAN-047 NaOAc




.1040 x 2 = .208

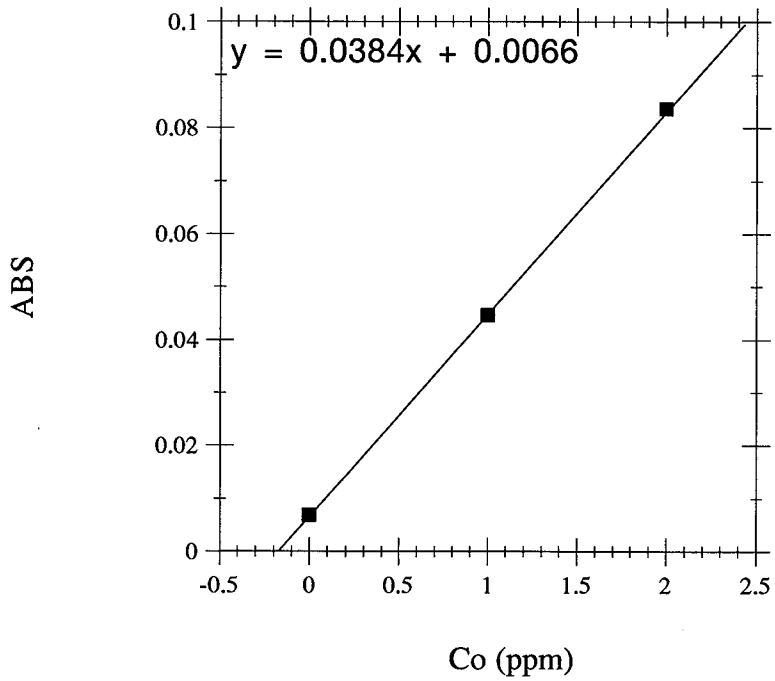
$\frac{.208 \times 8}{1.023} = .8136$ ppm

SAN-048 NaOAc

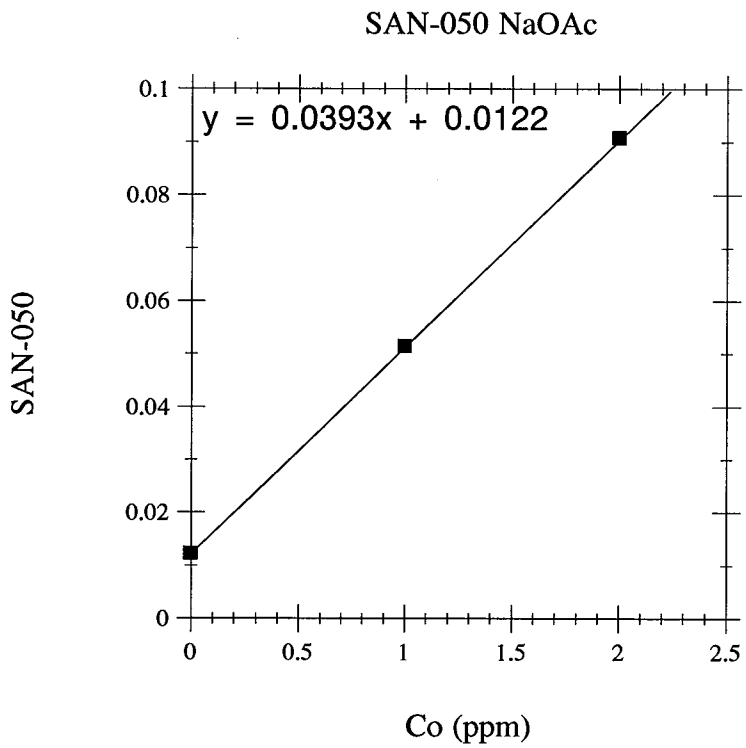



$.2085 \times 2 = \frac{.417 \times 8}{1.022} = 3.264$ ppm

SAN-049 NaOAc

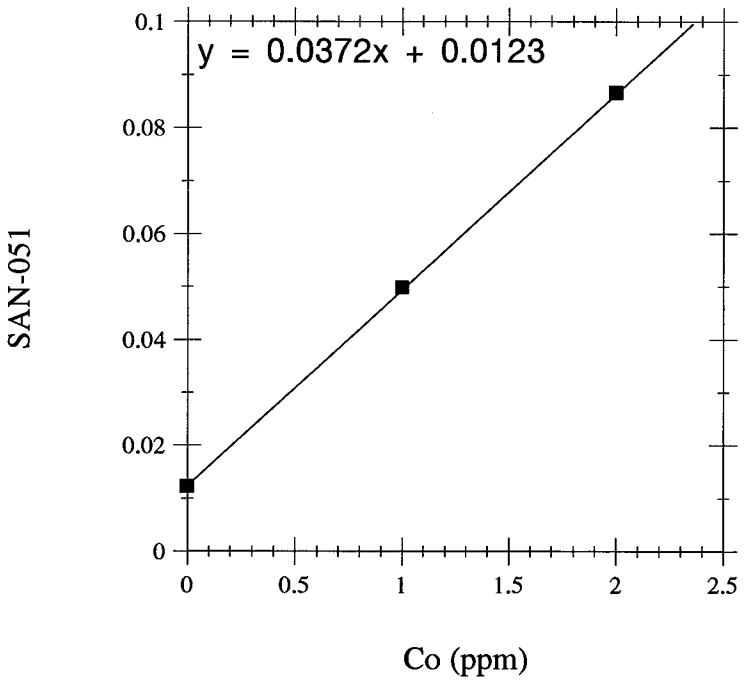



$.1719 \times 2 = .3438 \div \frac{8}{1.017} = 2.704$ ppm



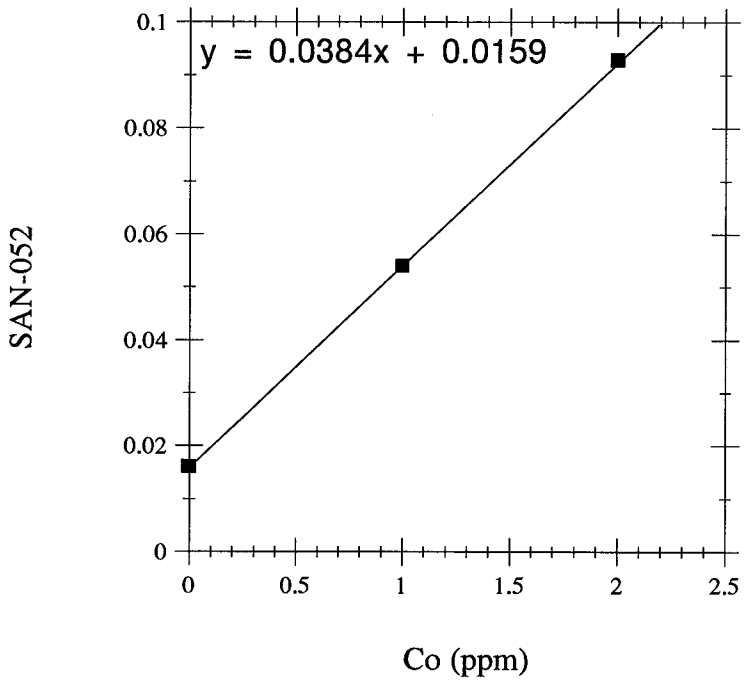

$.3104 \times 2 = .6208 \times \frac{8}{1.016} = 4.888$ ppm

SAN-051 NaOAc



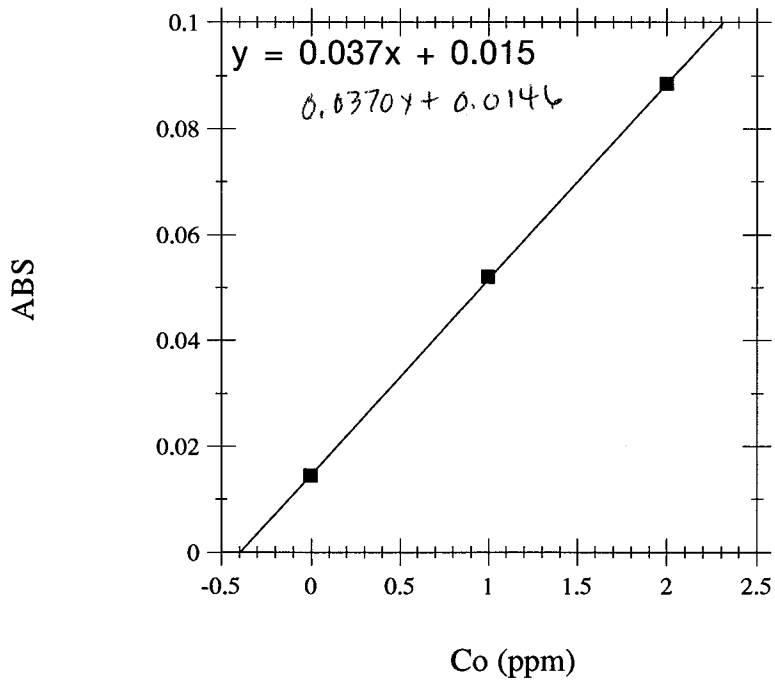

$.3306 \times 2 = .6612 \times \frac{8}{1.017} = 5.201$ ppm

SAN-052 NaOAc




$.4141 \times 2 = .8282 \times \frac{8}{1.02} = 6.496\,ppm$

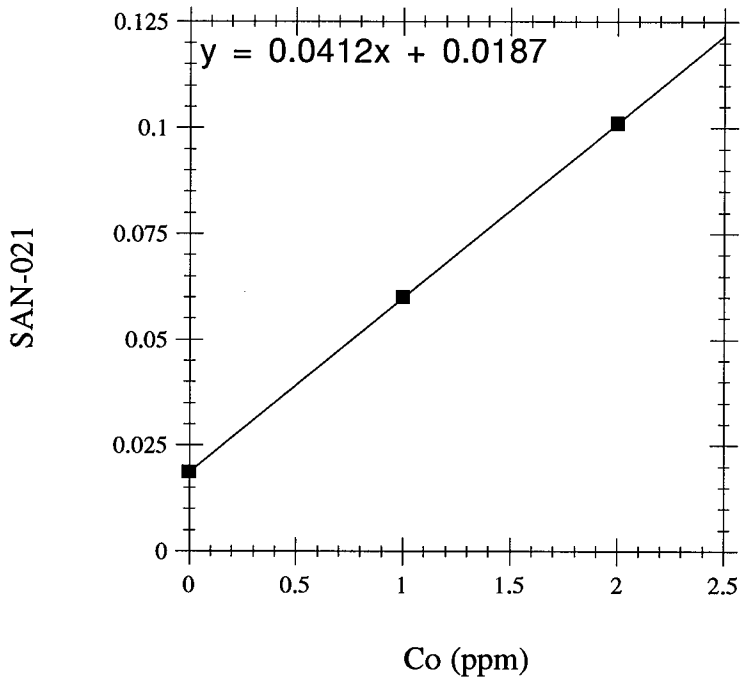
SAN-053 NaOAc




.3946 x 2 = .7892

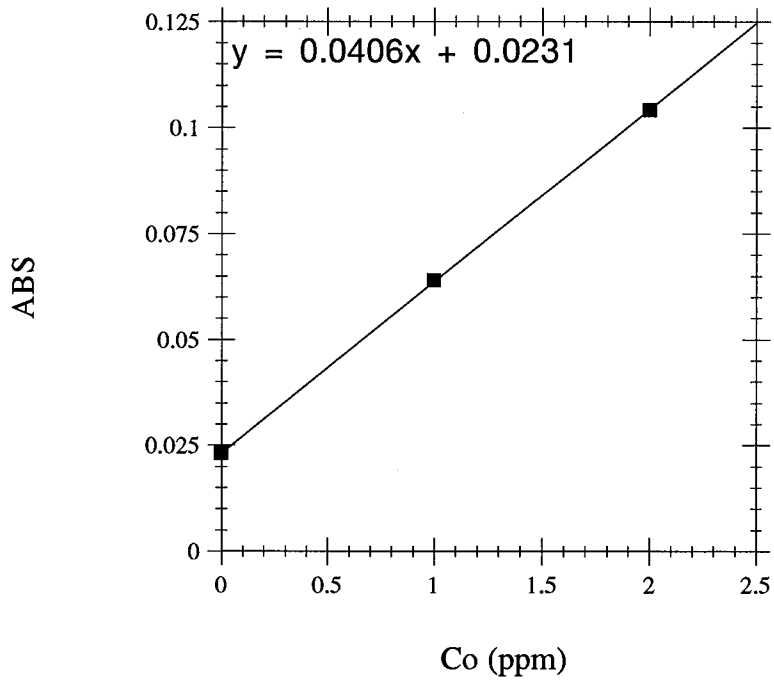
.7892 x 8/1.008 = 6.263 ppm

SAN-021 NH2OH




$.4539 \times 2 = .9078 \times \frac{8}{1.016} = 7.148$ ppm

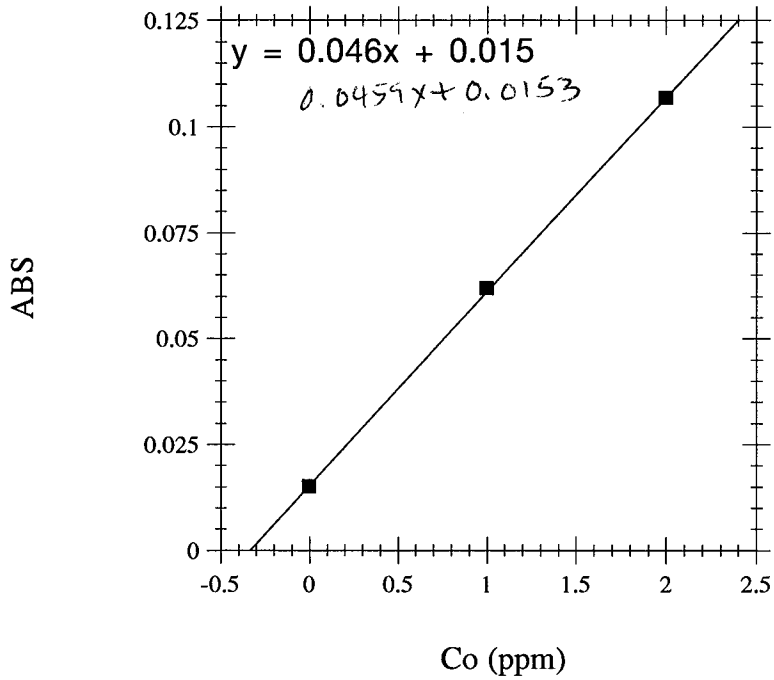
SAN-022 NH2OH




.5690 x 2 = 1.138

1.138 x 8 / 1.022 = 8.908 ppm

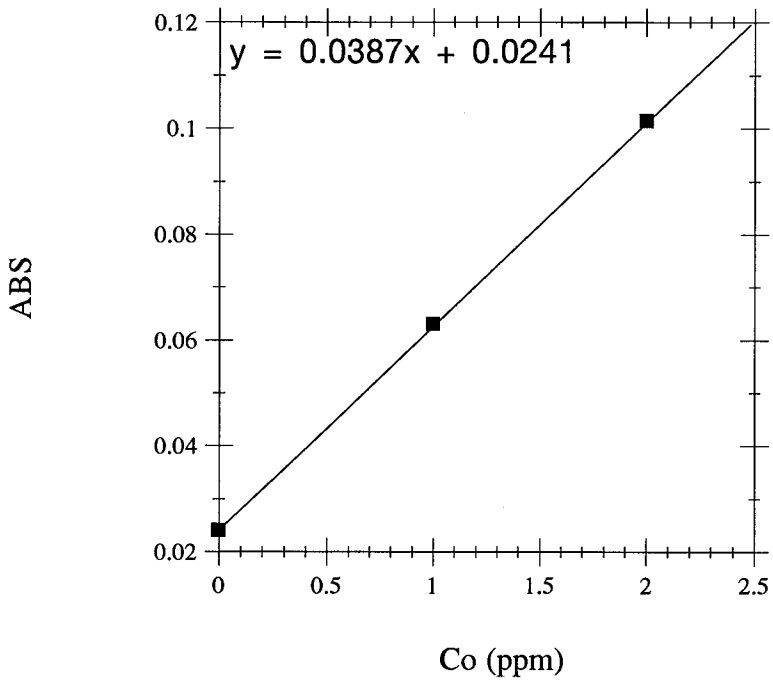
SAN-023 NH2OH




.3333 x 2 = .6666

.6666 x $\frac{8}{1.022}$ = 5.218 ppm

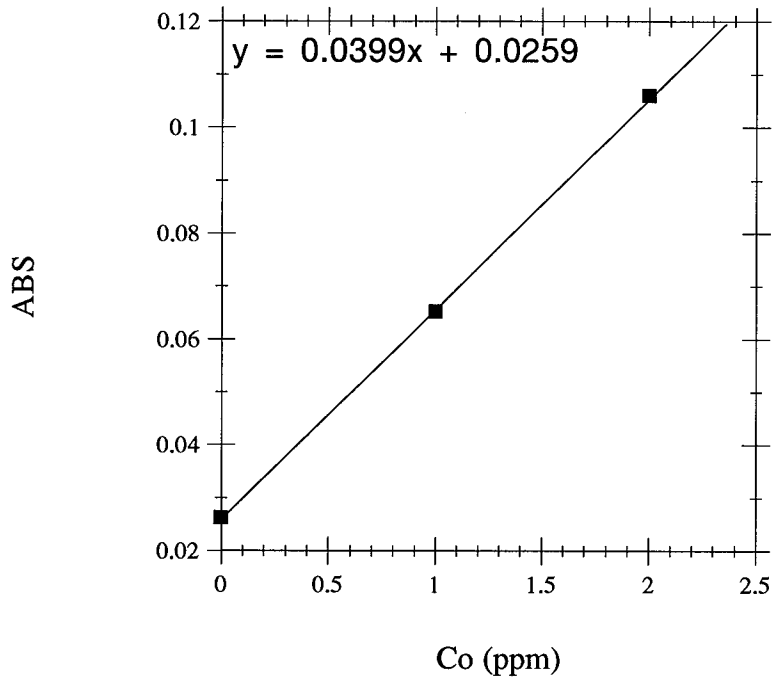
SAN-024 NH2OH




.6227 x 2 = 1.2454

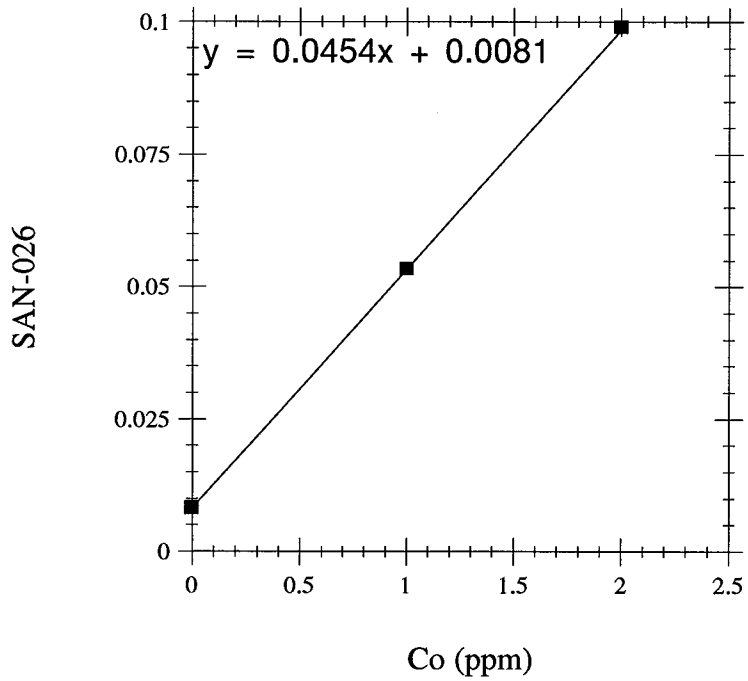
1.2454 x 8 / 1.018 = 9.787 ppm

SAN-025 NH2OH



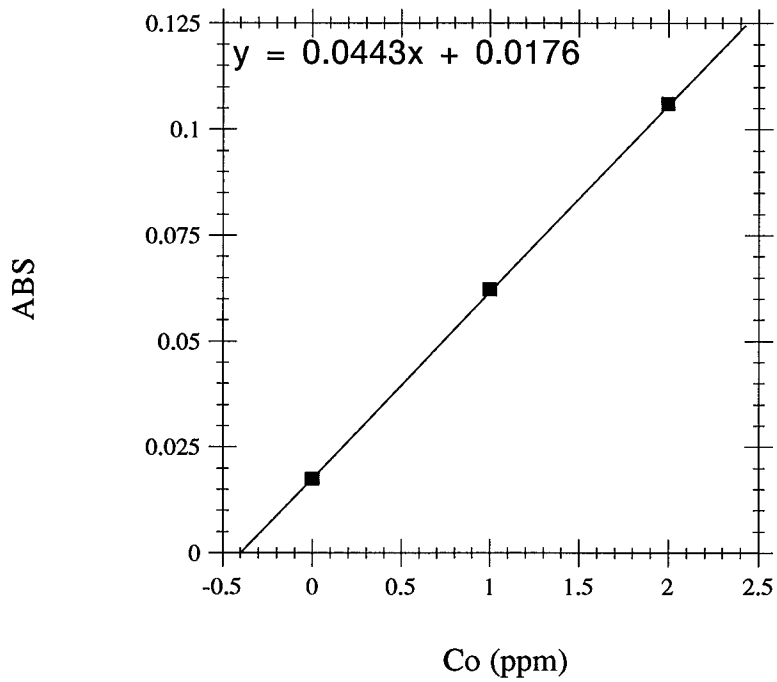

$.6491 \times 2 = 1.2982 \times \frac{8}{1.025} = 10.132$ ppm

SAN-026 NH2OH



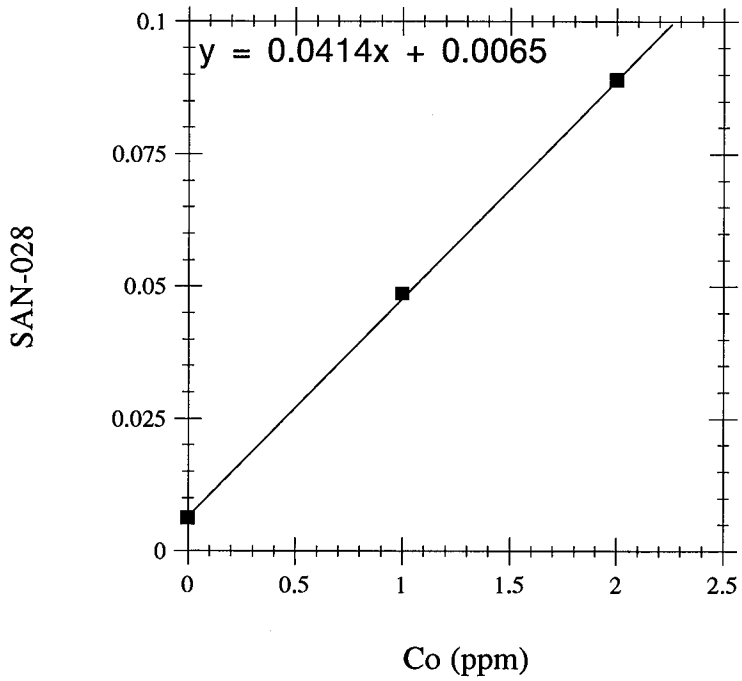

$.1784 \times 2 = .3568 \times \frac{8}{1.021} = 2.796$ ppm

SAN-027 NH2OH



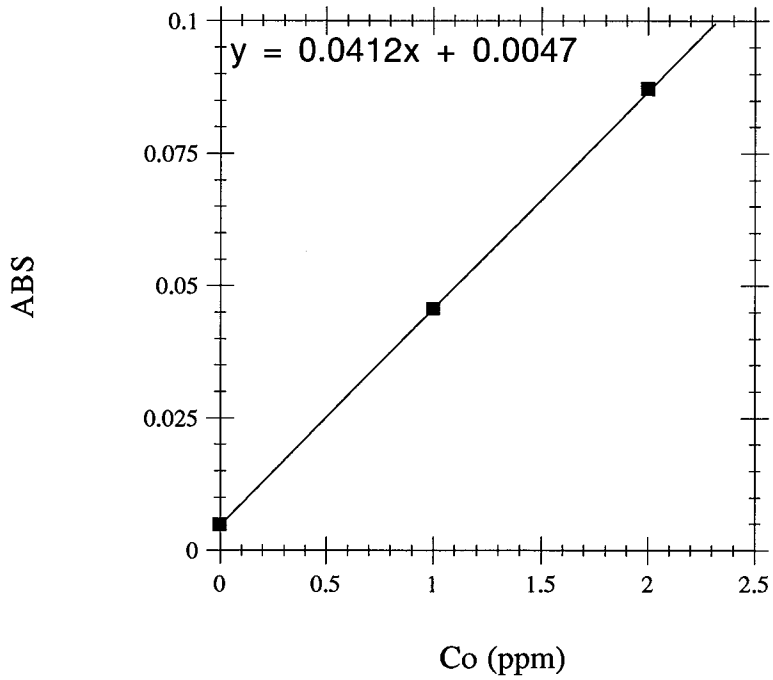

$.3973 \times 2 = .7946 \times \frac{8}{1.013} = 6.275$ ppm

SAN-028 NH2OH




$.157 \times 2 = .314 \times \frac{8}{1.023} = 2.455$ ppm

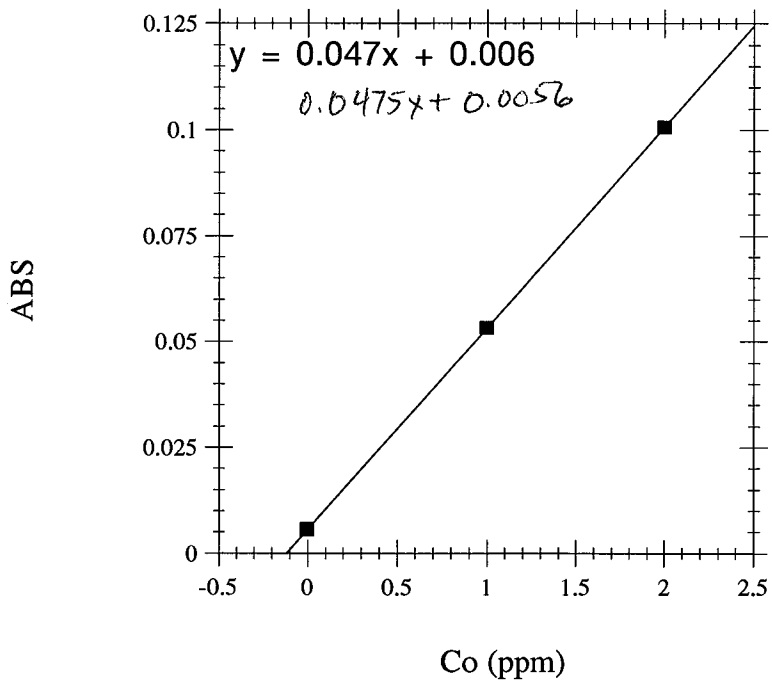
SAN-029 NH2OH




.1141 x 2 = .2282

$.2282 \times \frac{8}{1.02} = 1.790$ ppm

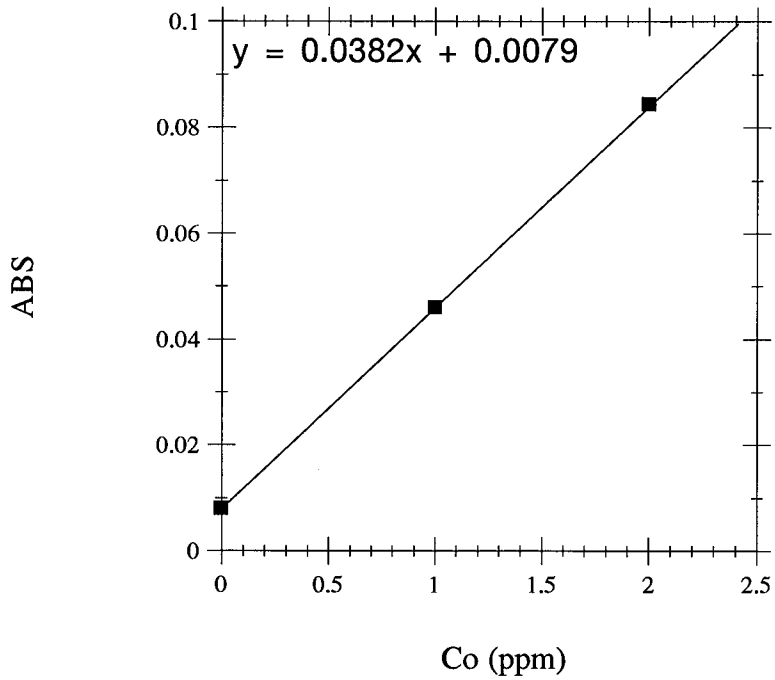
SAN-030 NH2OH




.1179 x 2 = .2358

$.2358 \times \frac{8}{1.022} =$ 1.846 ppm

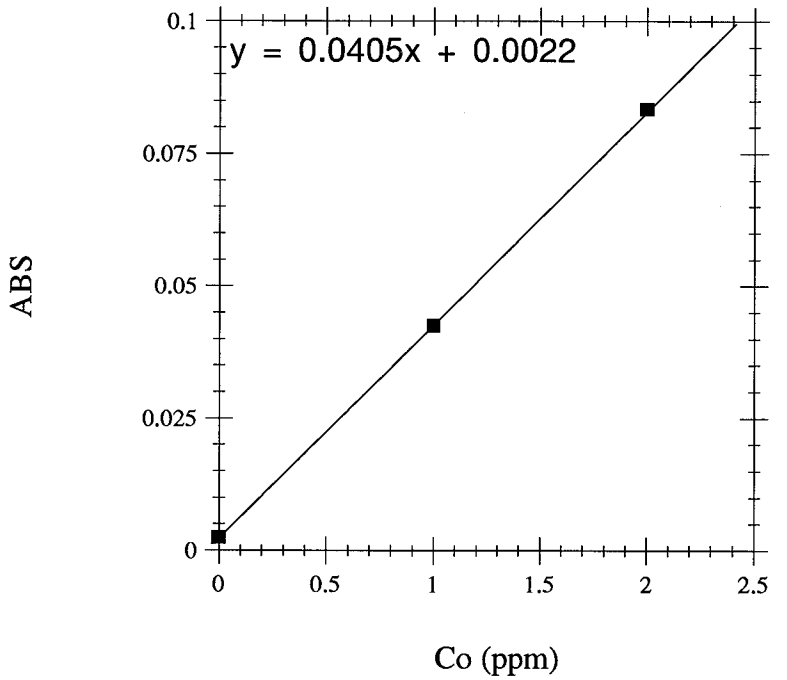
SAN-031 NH2OH




.2068 x 2 = .4136

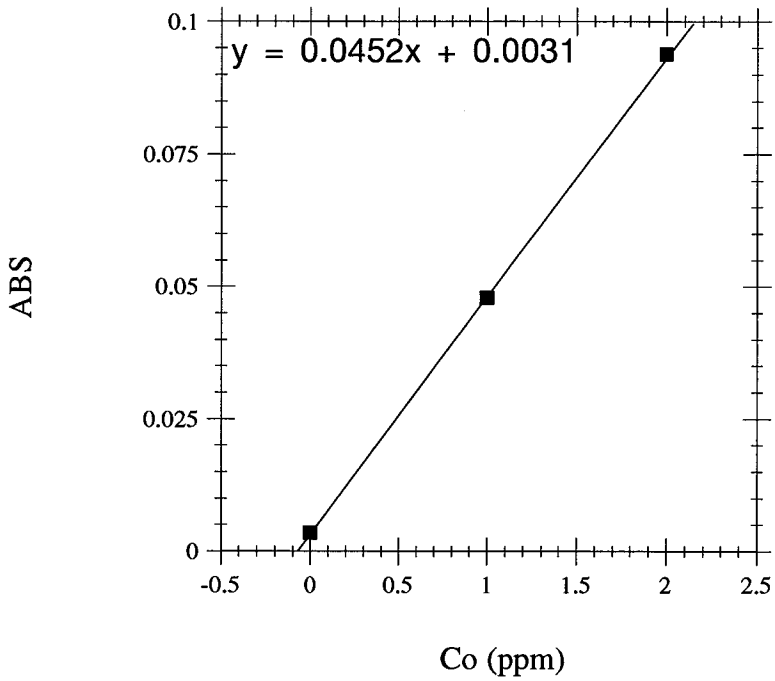
$.4136 \times \frac{8}{1.026} = 3.225 \text{ ppm}$

SAN-032 NH2OH



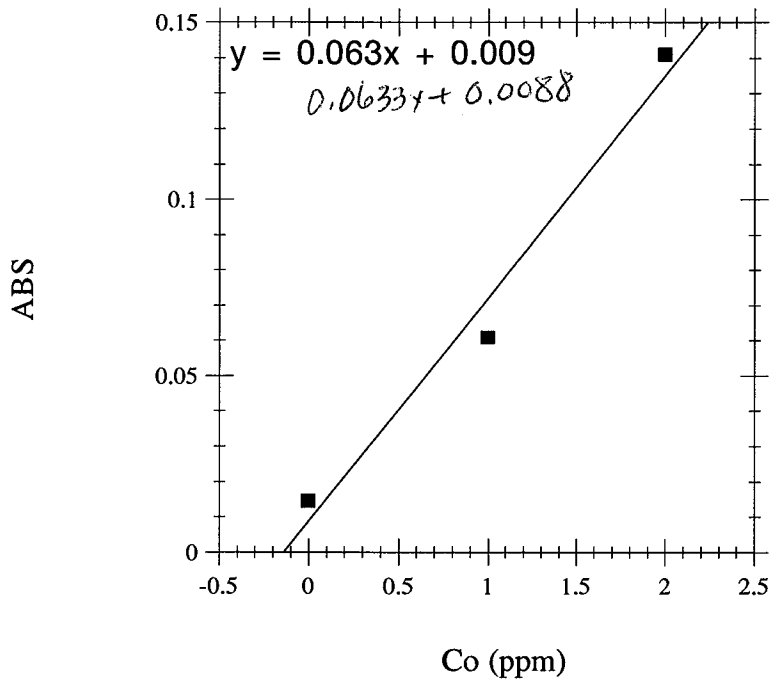

$.0543 \times 2 = .1086 \times \frac{8}{1.017} = .854$ ppm

SAN-033 NH2OH




.0686 x 2 = .1372 x 8/1.012 = 1.0840 ppm

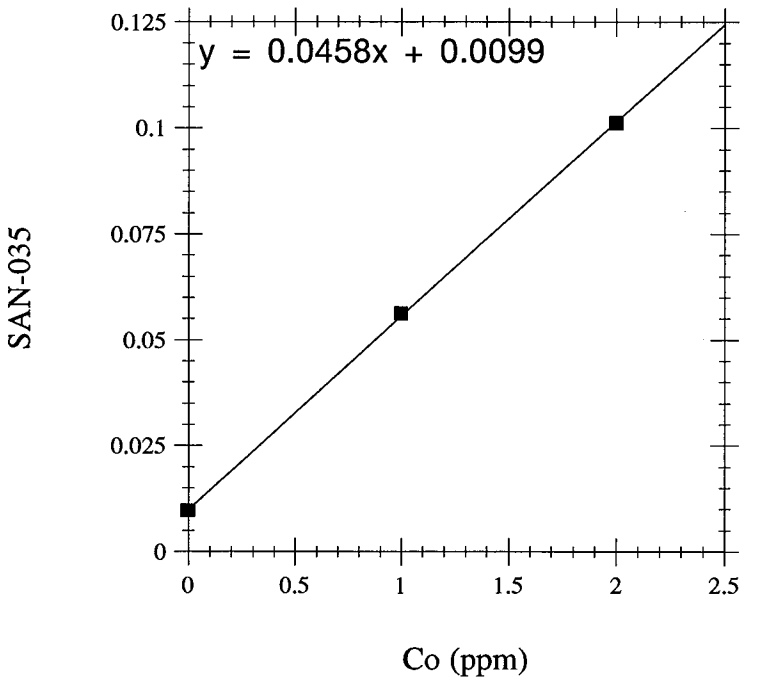
SAN-034 NH2OH




.139 x 2 = .278

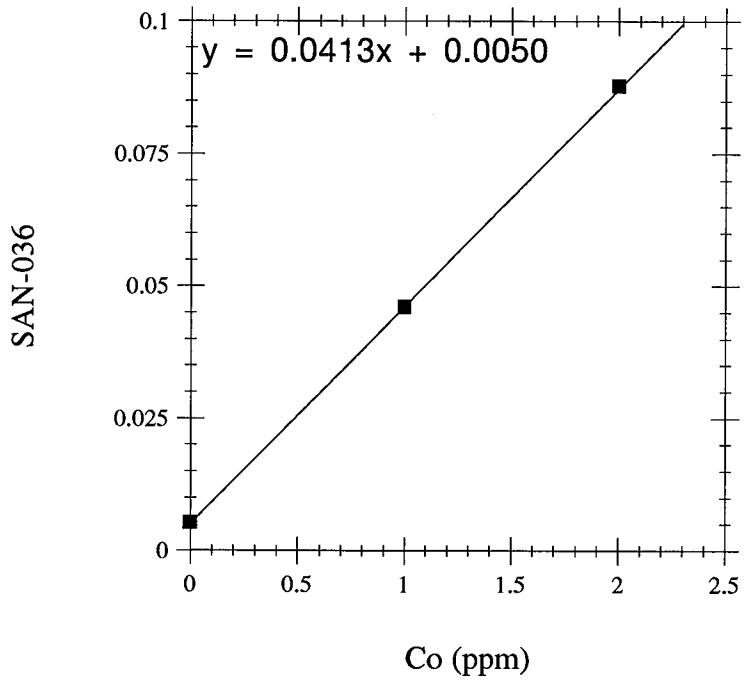
$.278 \times \frac{8}{1.009} = 2.204$ ppm

SAN-035 NH2OH



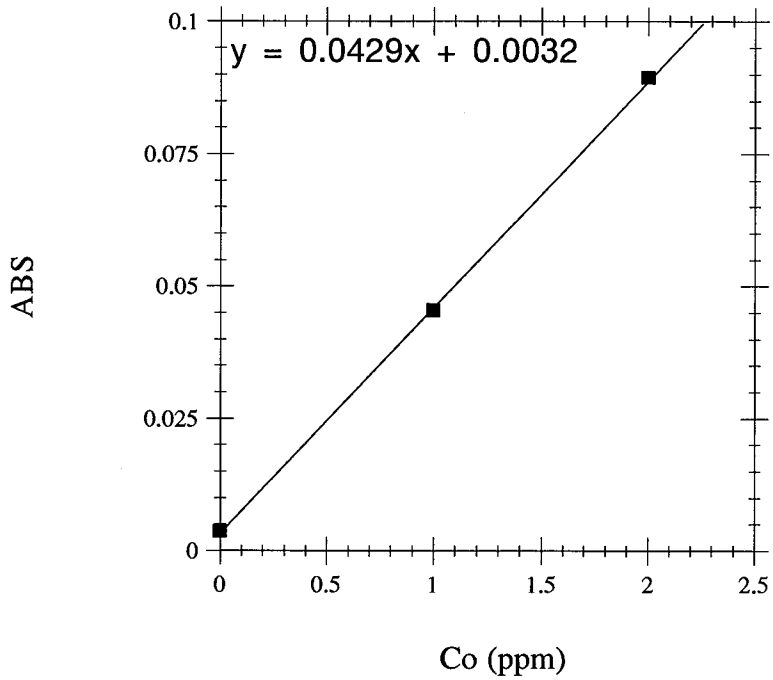

$.2162 \times 2 = .4324 \times \frac{8}{1.02} = 3.391$ ppm

SAN-036 NH2OH




$.1211 \times 2 = .2422 \times \frac{8}{1.014} = \underline{1.911 \text{ ppm}}$

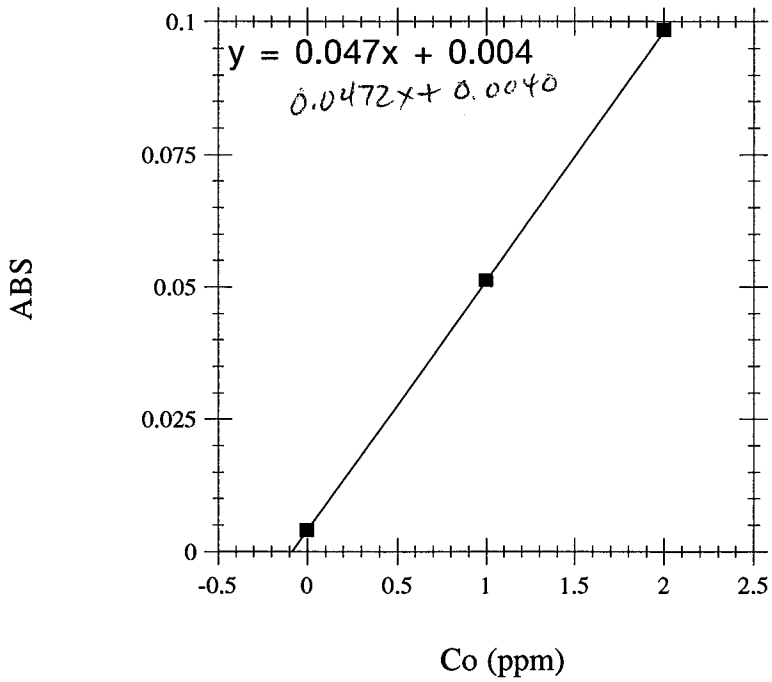
SAN-037 NH2OH




.0746 x 2 = .1492

$\frac{.1492 \times 8}{1.021} = 1.169$ ppm

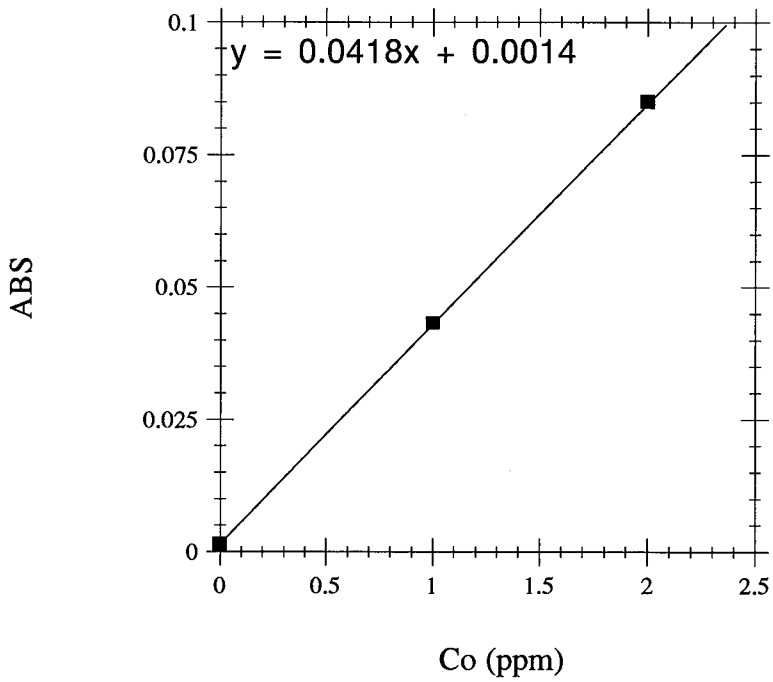
SAN-038 NH2OH




.0847 x 2 = .1694

.1694 x 8/1.024 = 1.323ppm

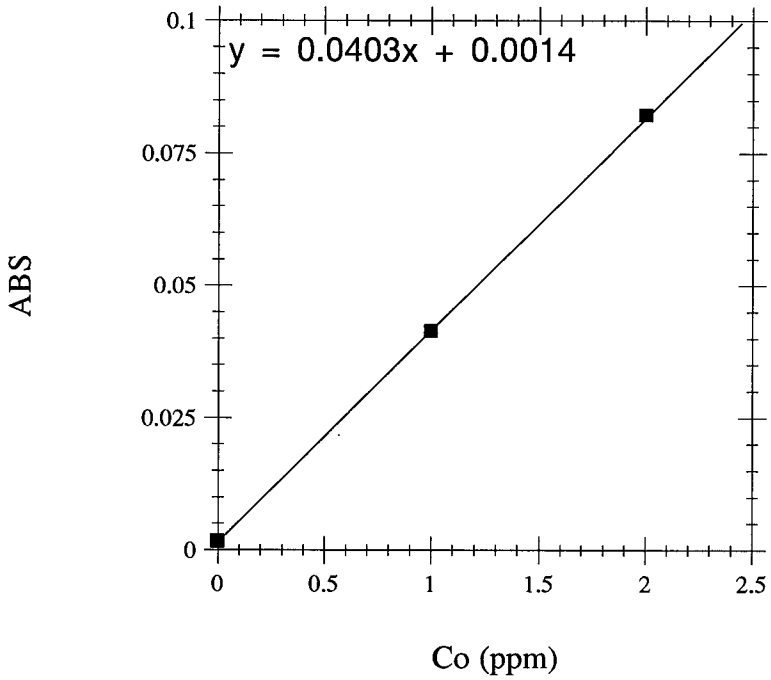
SAN-039 NH2OH




.0335 x 2 = .067

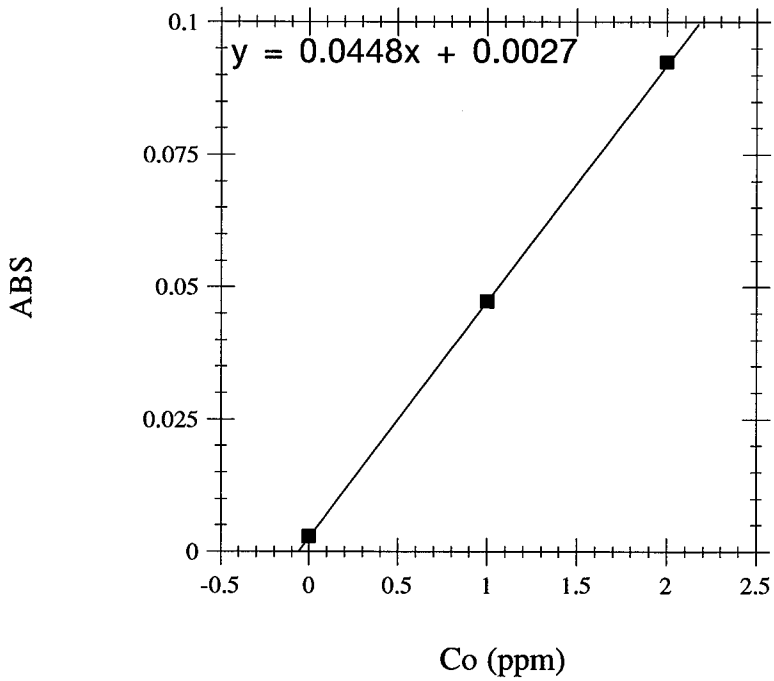
$.067 \times \frac{8}{1.018} = .526$ ppm

SAN-040 NH2OH



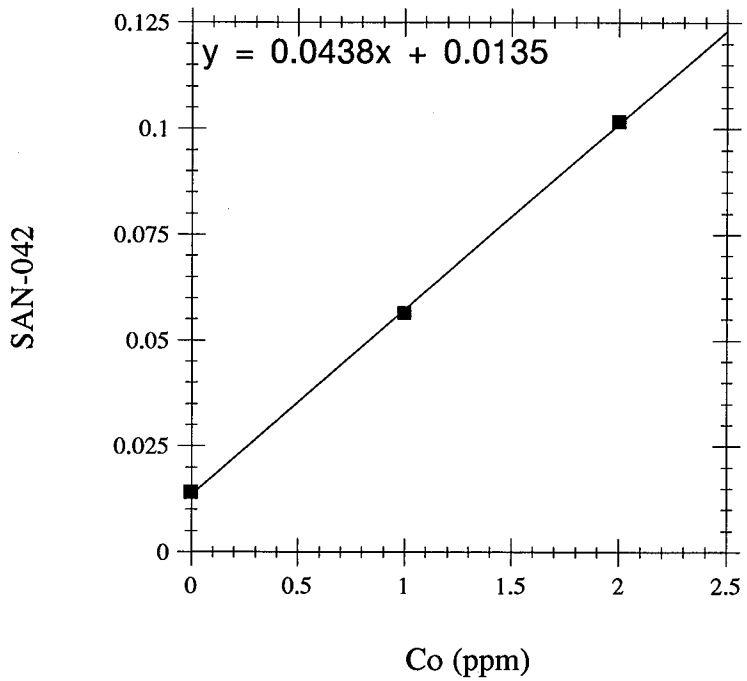

$.0347 \times 2 = .0694 \times \frac{8}{1.017} = .546$ ppm

SAN-041 NH2OH



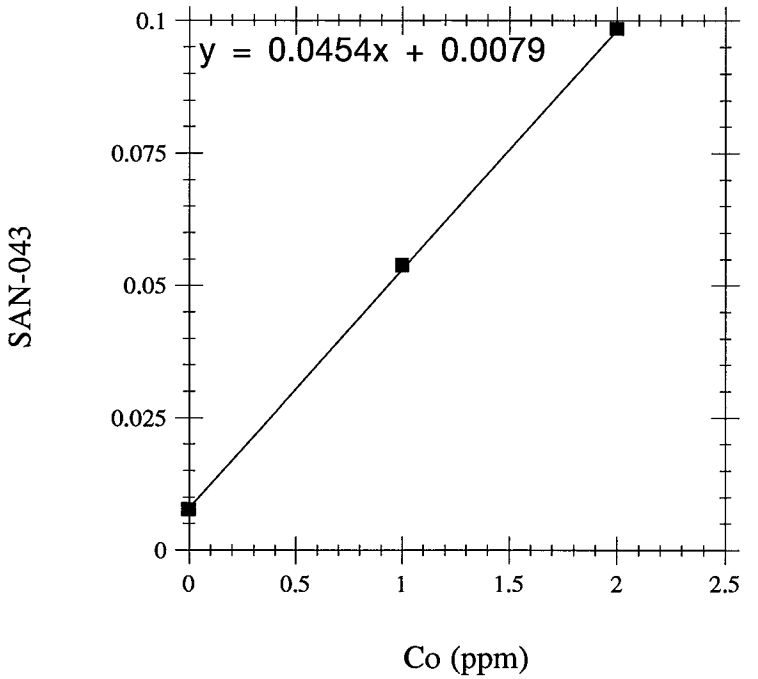

.0603 x 2 = .1206 x 8 / 1.015 = .950 ppm

SAN-042 NH2OH



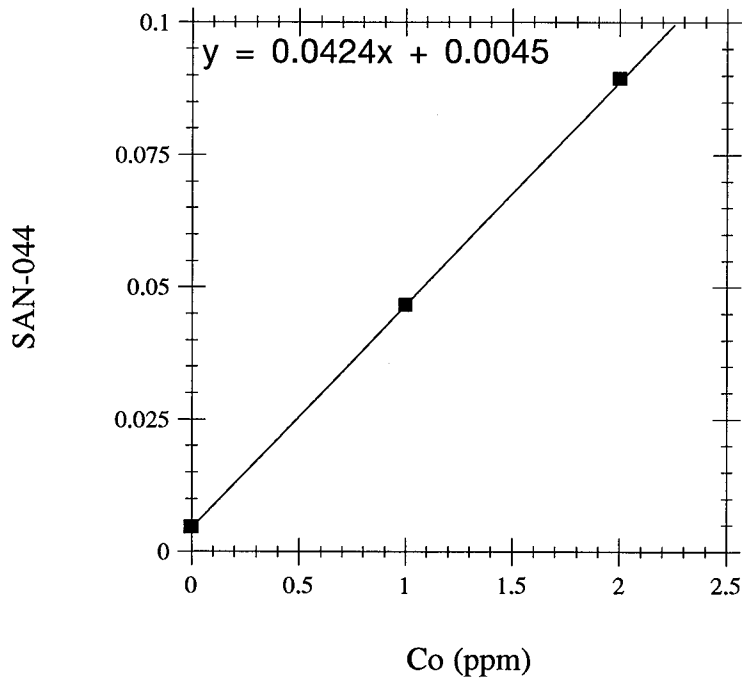

$.3082 \times 2 = .6164 \times \frac{8}{1.012} = 4.873\,ppm$

SAN-043 NH2OH



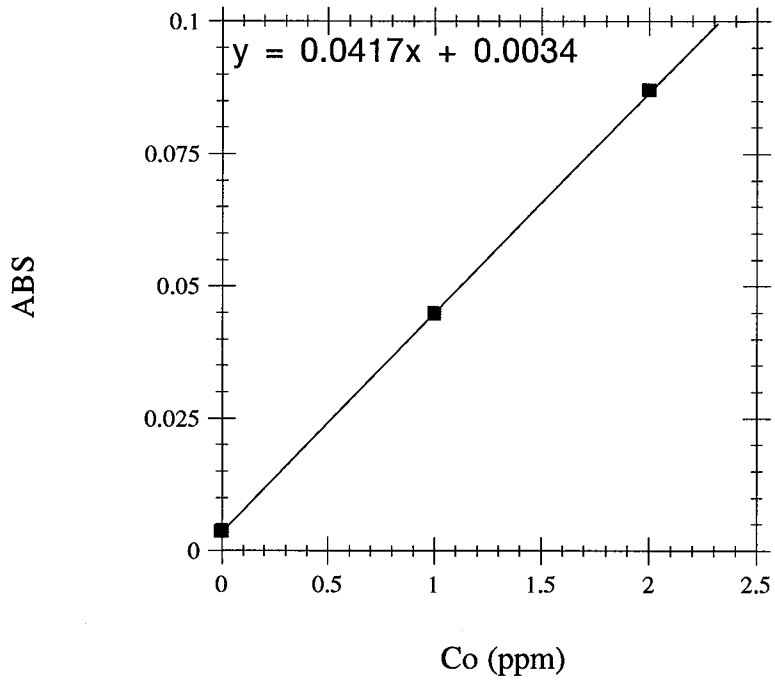

$.174 \times 2 = .348 \times \frac{8}{1.022} = 2.724 \text{ ppm}$

SAN-044 NH2OH




$.1061 \times 2 = .2122 + \frac{.8}{1.014} = \underline{1.674 \text{ ppm}}$

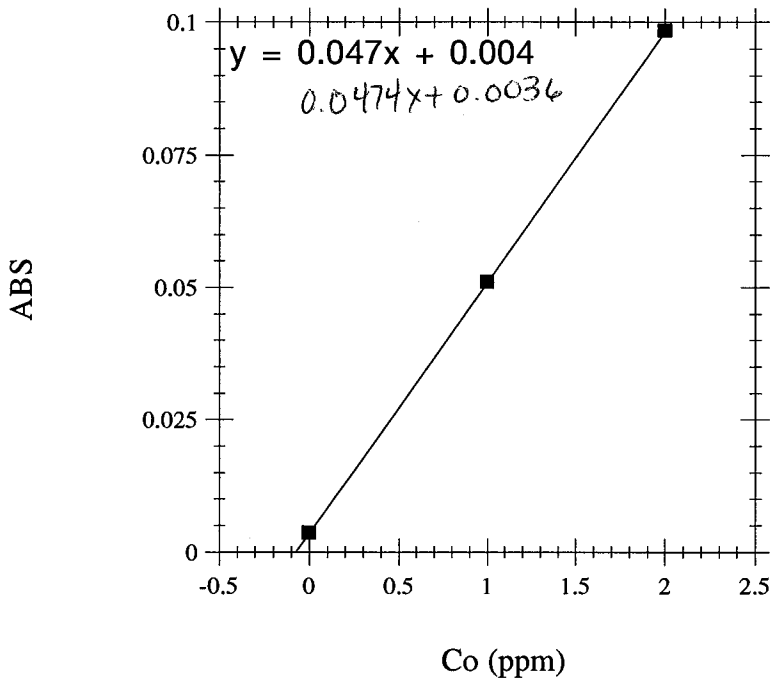
SAN-045 NH2OH




.0815 x 2 = .163

$\frac{.163 \times 8}{1.017} = 1.282$ ppm

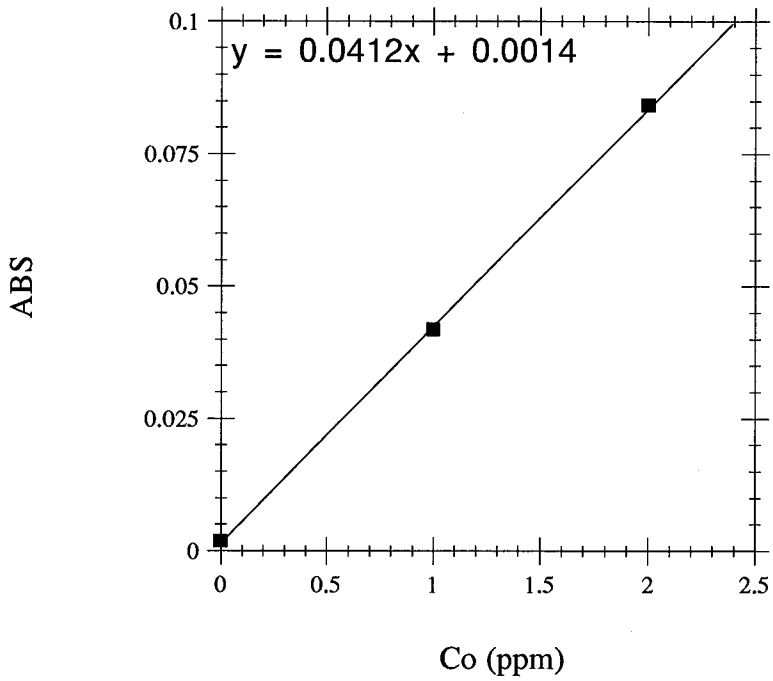
SAN-046 NH2OH




.07598 x 2 = ~~.1519~~ .1518

.1518 x 8/1.022 = 1.188 ppm

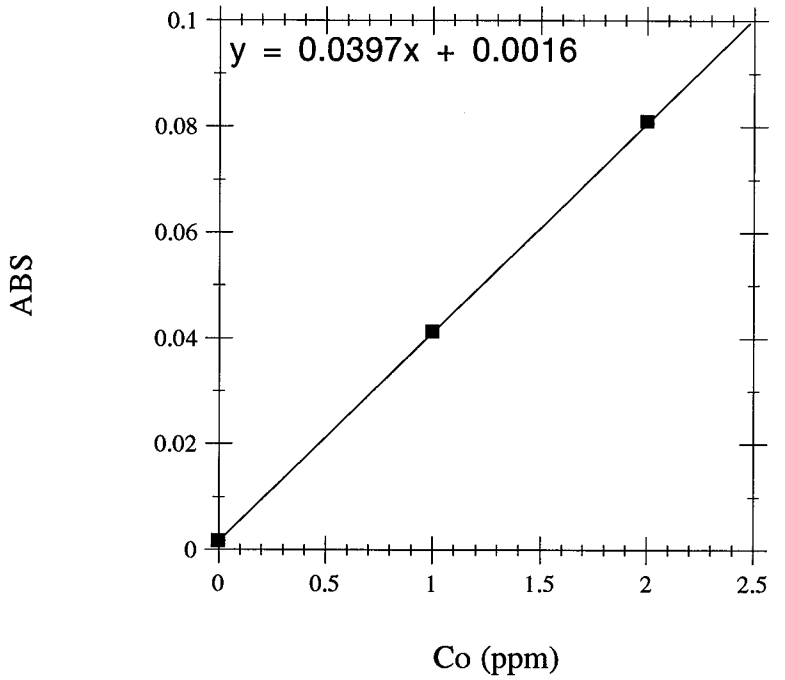
SAN-047 NH2OH




~~.033~~ .034 x 2 = .068

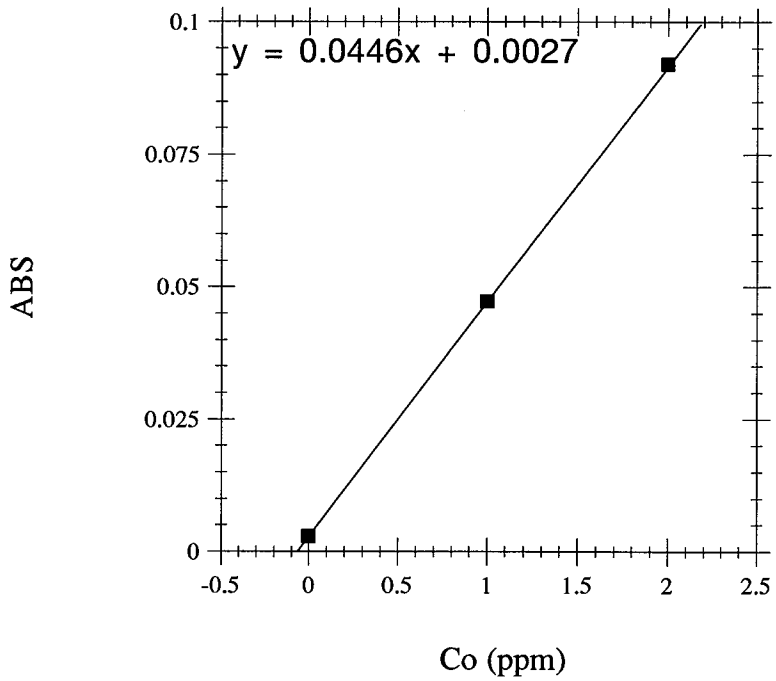
$.068 \times \frac{8}{1.023} = .532$ ppm

SAN-048 NH2OH



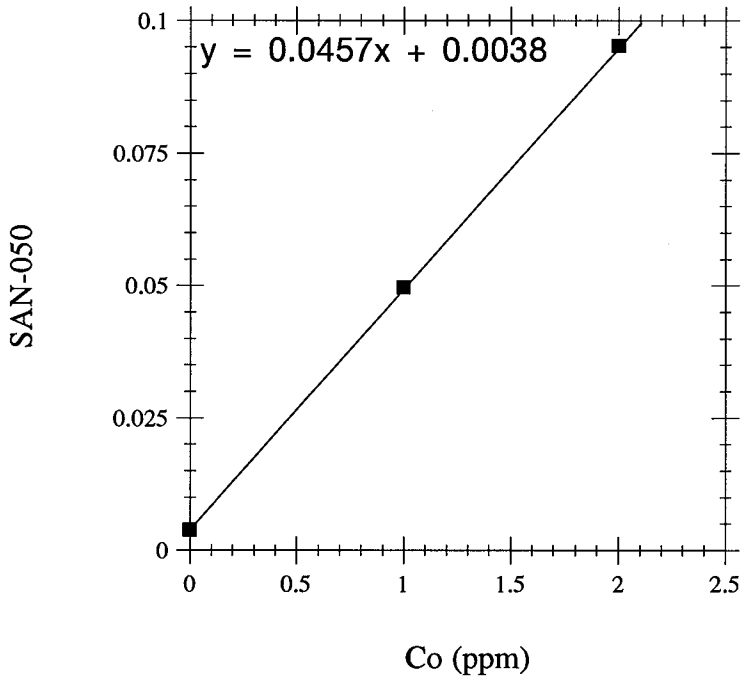

$.0403 \times 2 = .0806 \times \frac{8}{1.022} = .631$ ppm

SAN-049 NH2OH



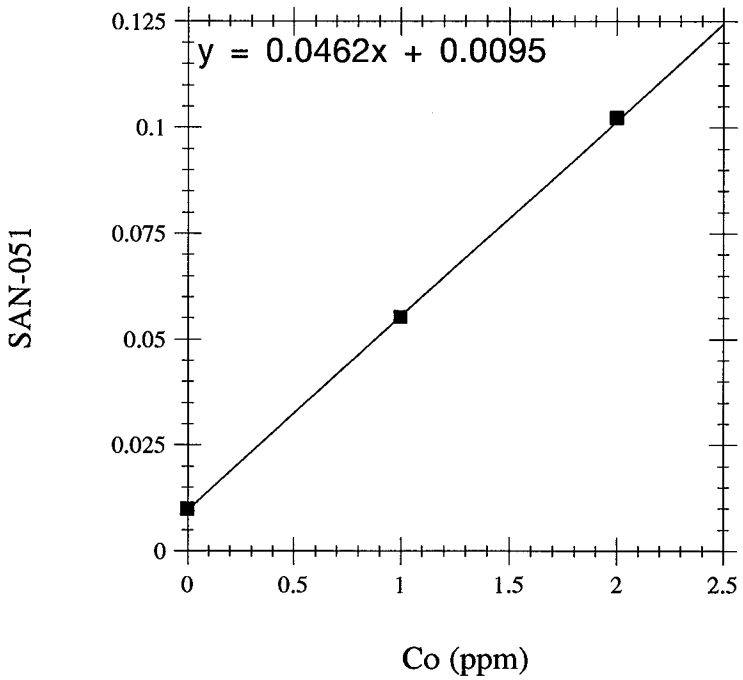

.0605 x 2 = .1210 x 8/1.017 = .952 ppm

SAN-050 NH2OH



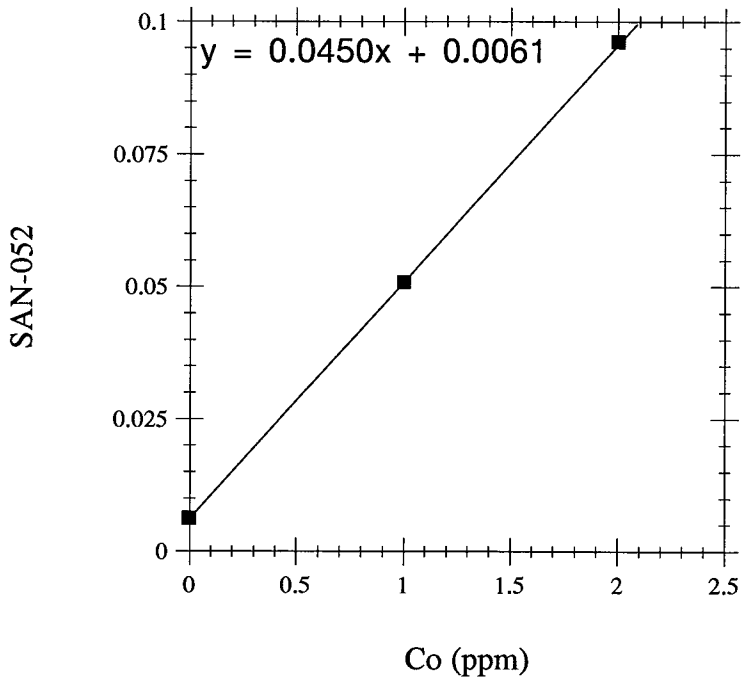

$.0831 \times 2 = .1662 \times \frac{8}{1.016} = 1.3087 \text{ ppm}$

SAN-051 NH2OH



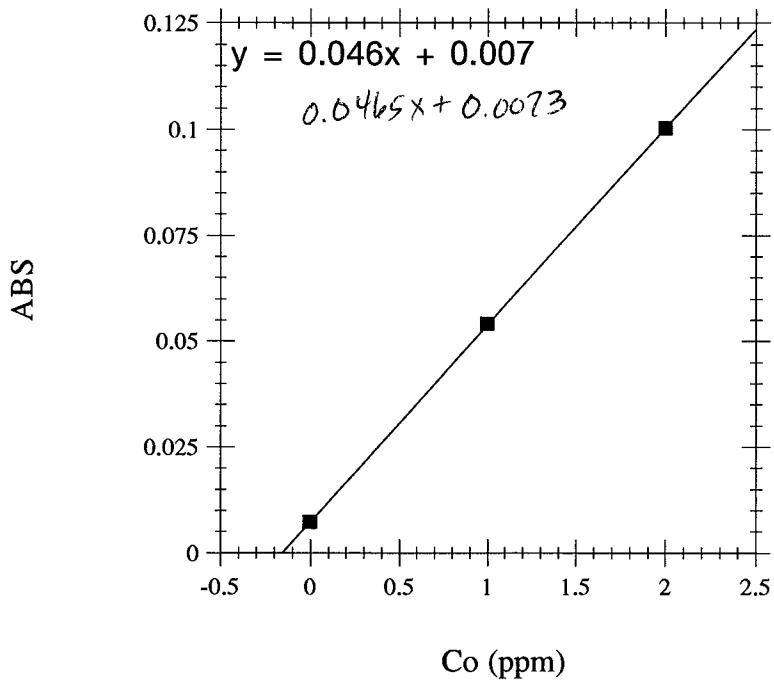

$.2056 \times 2 = .4112 \times \frac{8}{1.017} = 3.235$ ppm

SAN-052 NH2OH




$.1355 \times 2 = .271 \times \frac{8}{1.02} = 2.125$ ppm

SAN-053 NH2OH

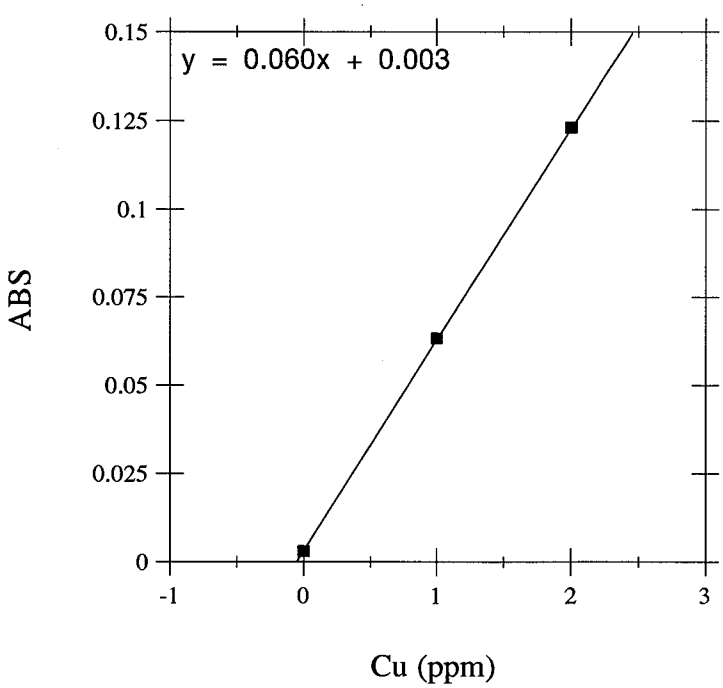



.1569 x 2 = .3138

.3138 x 8/1.008 = 2.490 ppm

| | SAN023 MgCl | SAN030 MgCl | SAN023 NaOAC | SAN030 NaOAc | SAN023 $NH_2OH$ | SAN-030 $NH_2OH$ |
|---|---|---|---|---|---|---|
| Pb A | .006 .005 .004 .004 .004 | .005 .004 .004 .005 .004 | .003 .004 .004 .003 .004 | .004 .004 .005 .005 .004 | .001 .000 .000 .000 .001 | .002 .001 .000 .000 .000 |
| Zn | .006 .007 .007 .007 .007 | .006 .006 .007 .007 .006 | .017 .016 .015 .016 .016 | .028 .027 .028 .028 .028 | .111 .111 .110 .109 .110 | .039 .040 .040 .040 .040 |
| B | .027 .027 .028 .028 .028 .146 .144 .147 .146 .145 | .028 .027 .027 .028 .028 .131 .130 .132 .130 .131 | .029 .028 .029 .028 .028 .148 .147 .147 .147 .145 | .028 .028 .028 .029 .029 .159 .159 .158 .157 .161 | .028 .027 .028 .027 .027 .256 .251 .256 .254 .255 | .030 .029 .029 .028 .029 .191 .190 .192 .192 .190 |
| C | .051 .051 .050 .051 .050 .265 .263 .265 .258 .257 | .053 .053 .053 .054 .053 .259 .255 .253 .254 .254 | .054 .054 .053 .054 .053 .271 .275 .275 .273 .277 | .053 .054 .053 .053 .052 .290 .287 .291 .289 .288 | .055 .055 .056 .054 .055 .394 .398 .395 .396 .395 | .057 .057 .056 .056 .057 .333 .335 .333 .336 .335 |

SAN-023 $MgCl_2$



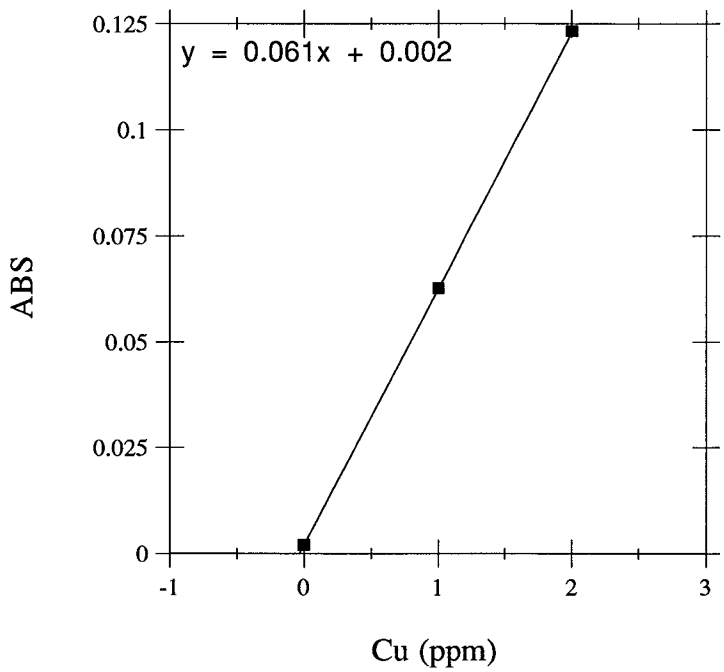

.05 ppm

X2 = .10 ppm

.10ppm $\frac{8\text{ g soln}}{1.019\text{ g solid}}$ =

0.785 ppm

SAN-030 $MgCl_2$



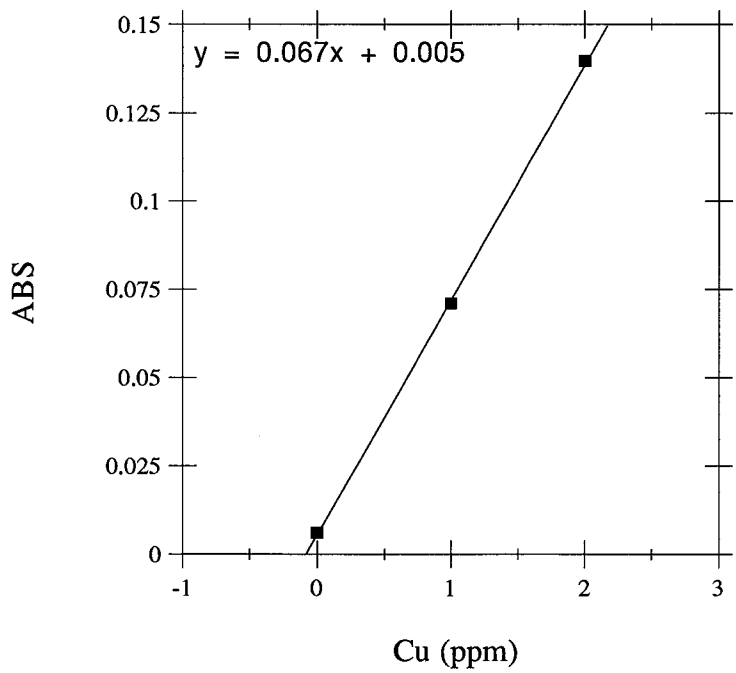

.033 ppm

x2 = .066

.066 ~~3mg~~ soln / 1.023g solid

0.516 ppm

SAN-023 NaOAc



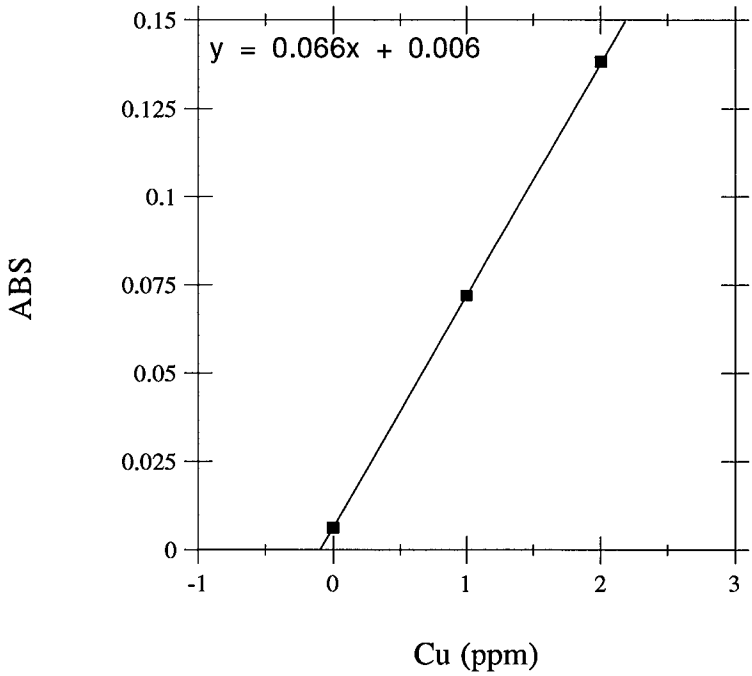

.075 ppm

x2 = .15 ppm

$.15 \text{ ppm} \times \frac{8 \text{ g soln}}{1.019 \text{ g solid}} =$

1.178 ppm

SAN-030 NaOAc



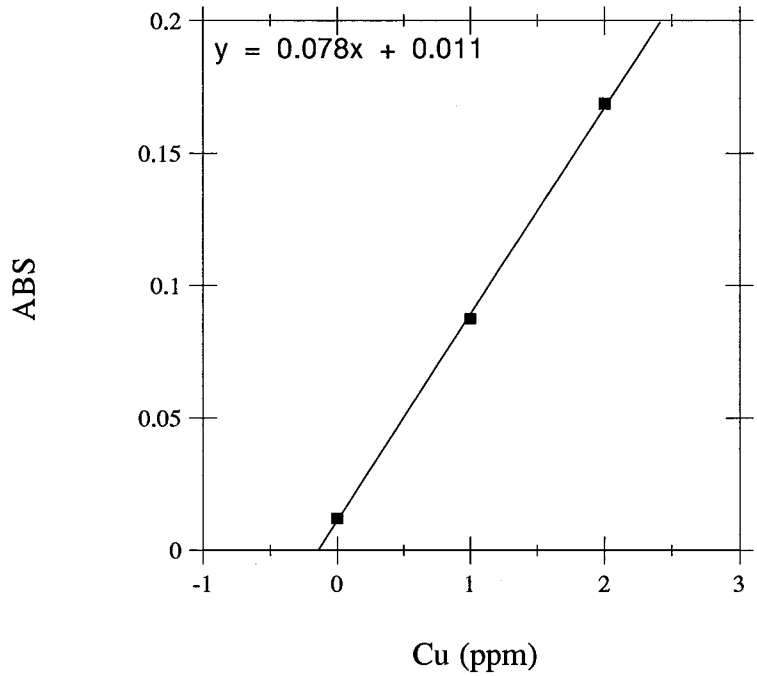

.091 ppm

×2 = .182 ppm

$.182 \times \frac{8\ g\ soln}{1.023\ g\ solid} =$

1.423 ppm

SAN-023 $NH_2OH$



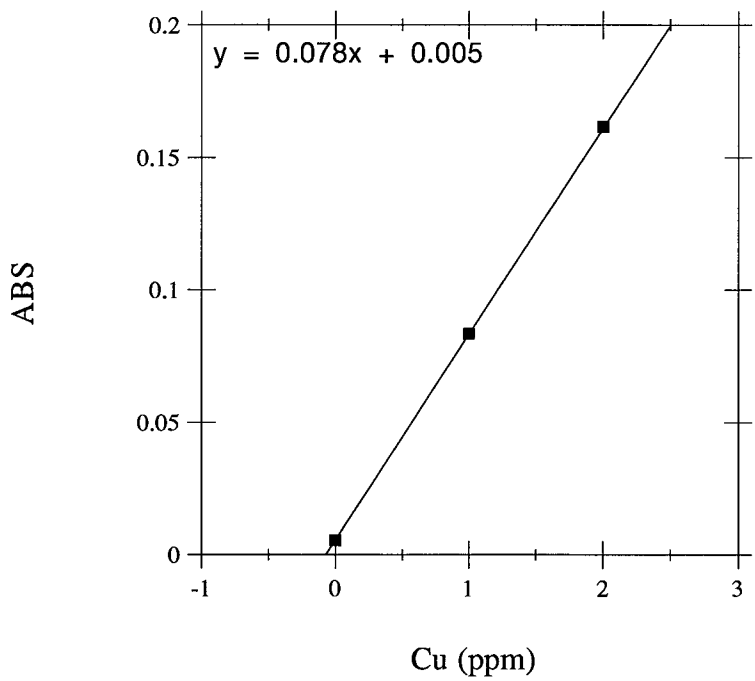

0.141 ppm

x2 = .282 ppm

$.282 \times \frac{8\ \text{g solw}}{1.019\ \text{g solid}} =$

2.214 ppm

SAN-030 $NH_2OH$



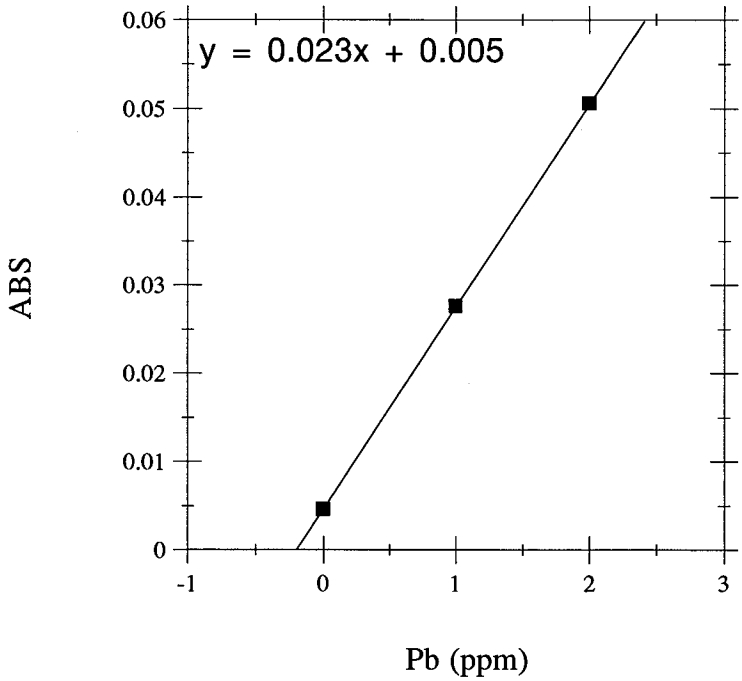

.064 ppm

x2 = .128 ppm

$.128 \times \frac{8\ g\ soln}{1.023\ g\ soln} =$

1.00 ppm

SAN-023 $MgCl_2$

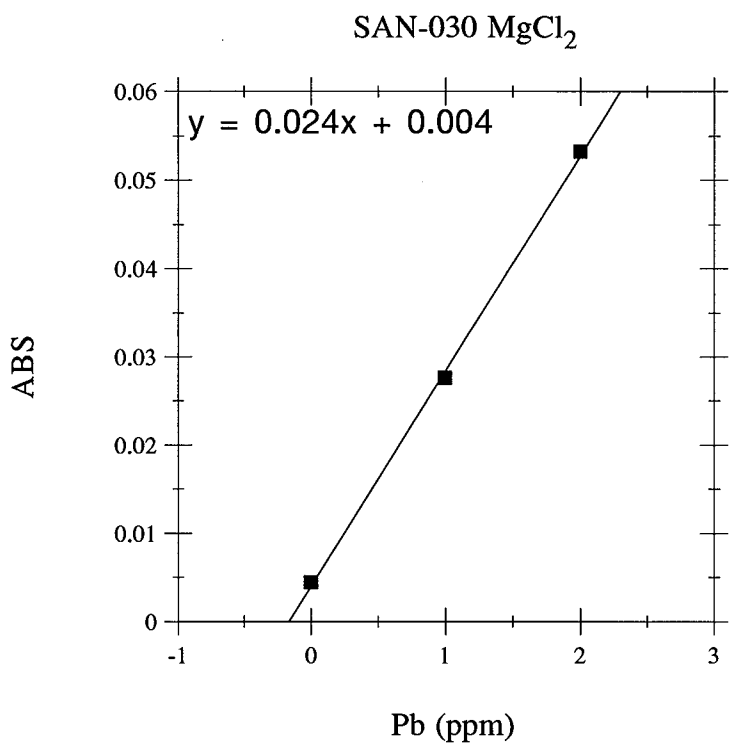



.217 ppm

x2 = .434 ppm

$.434 \text{ ppm} \times \frac{8 \text{ mg soln}}{1.015 \text{ g solid}}$

3.41 ppm

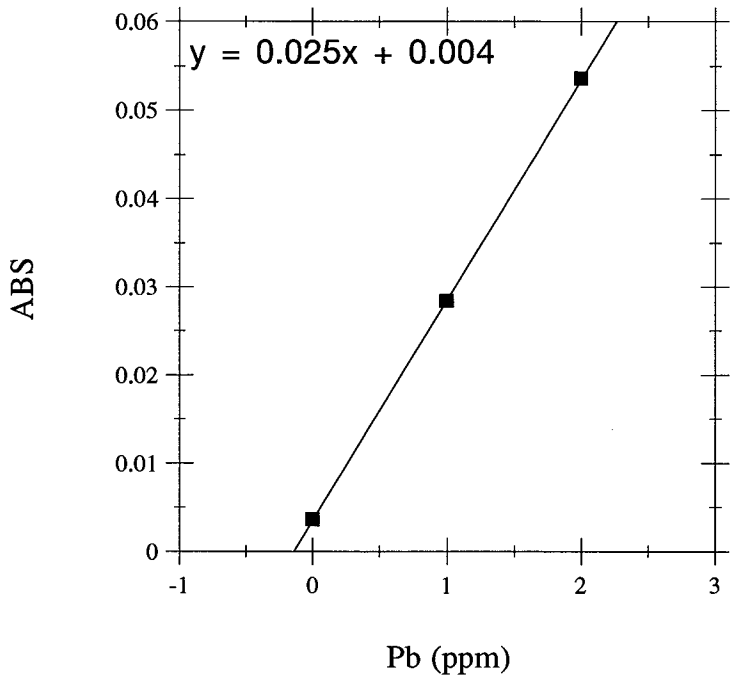



.167 ppm

x2 = .334 ppm

$.334 \times \frac{8\text{ g solw}}{1.023\text{ g solid}}$

2.61 ppm



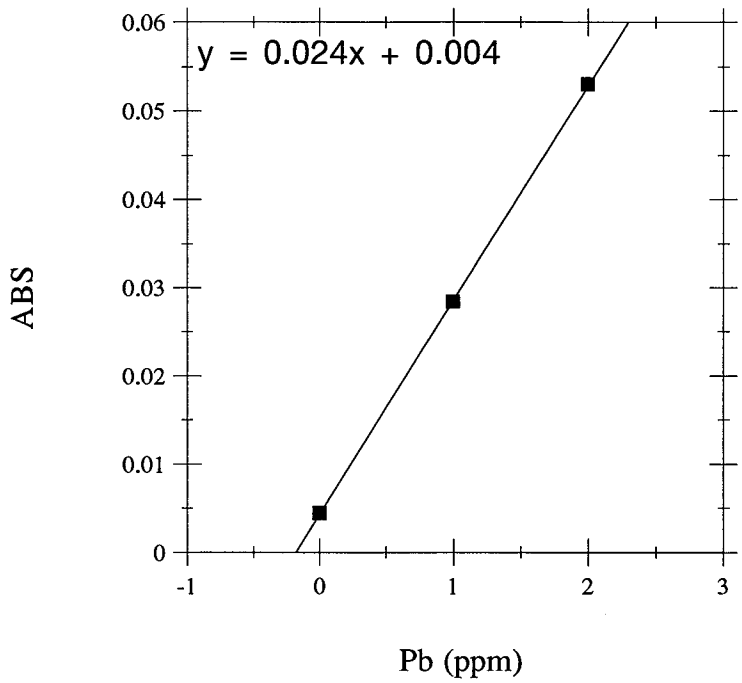

0.16 ppm

x2 = .32 ppm

$.32 \times \frac{8g\ soln}{1.019g\ soln}$

1.256 ppm

SAN-030 NaOAc



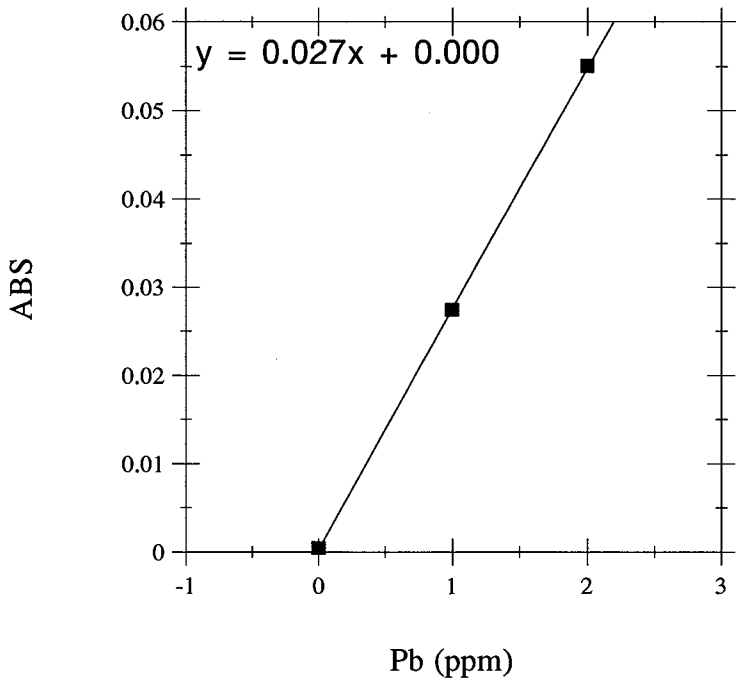

.167 ppm

x2 = .334 ppm

$.334 \times \frac{8\,g\ soln}{1.023\,g\ solid}$

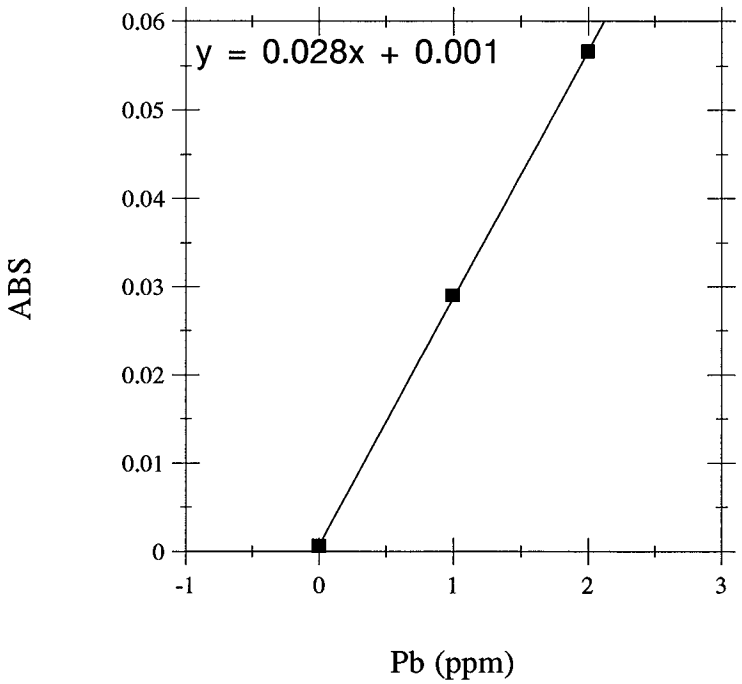
2.61 ppm

SAN-023 $NH_2OH$




0ppm

SAN-030 $NH_2OH$



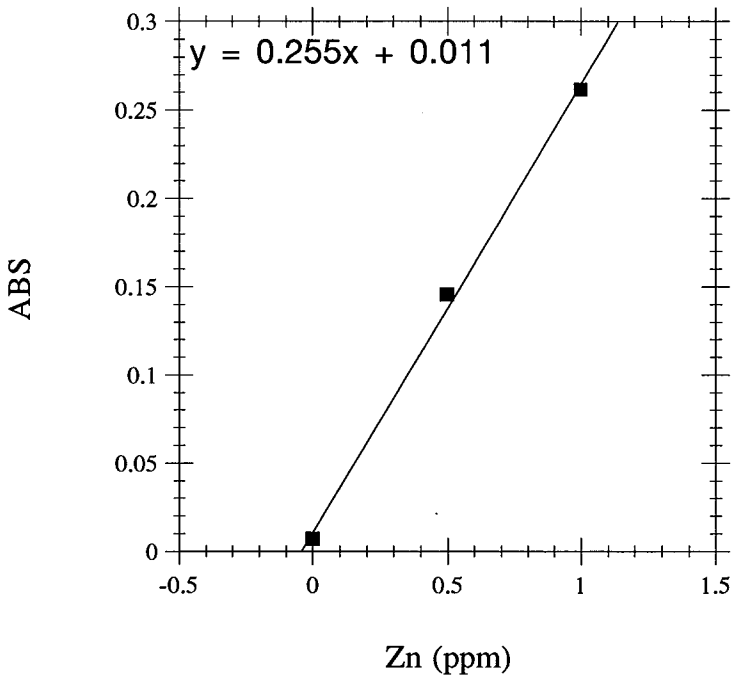

.036 ppm

x2 = .072 ppm

$.072 \times \frac{8\ g\ solw}{1.023\ g\ sol.\ \emptyset}$

.563 ppm

SAN-023 $MgCl_2$



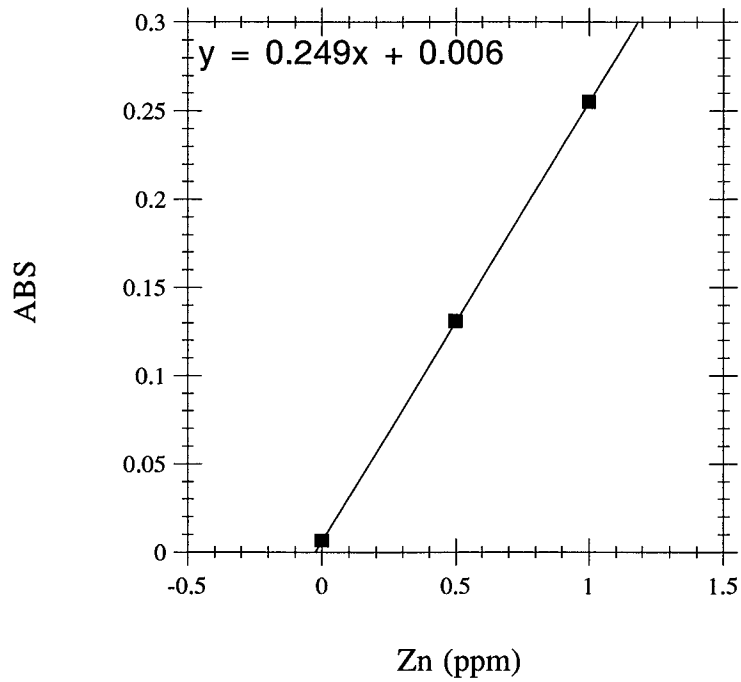

.043

x2 = .086

$.086 \times \frac{8g \text{ soln}}{1.019 g \text{ soln}}$

.1675 ppm

SAN-030 $MgCl_2$



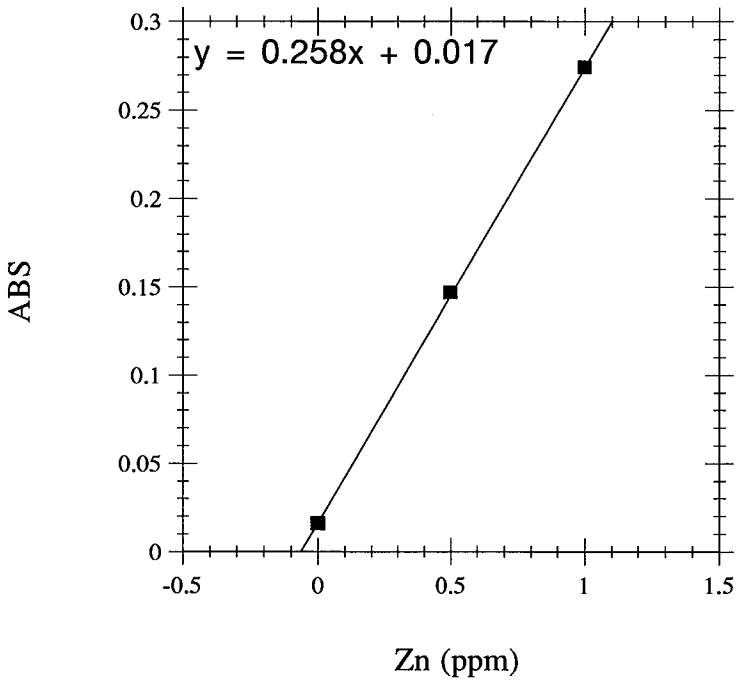

.024

x2 = .048

$.048 \times \frac{8\text{g sdw}}{1.023\text{g solid}}$

.375 ppm

SAN-023 NaOAc

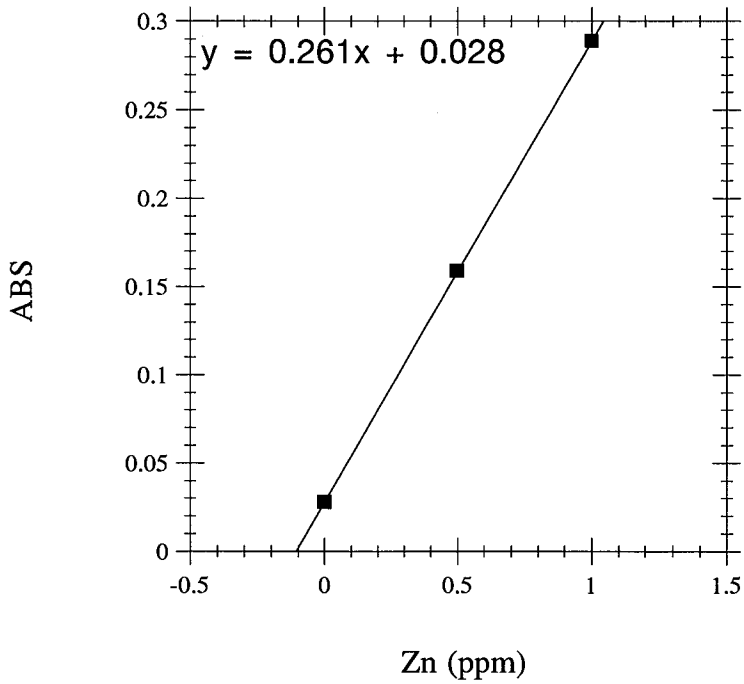



.066 ppm

x2 = .132

$.132 \times \frac{8g \text{ soln}}{1.019g \text{ solid}}$

1.036 ppm



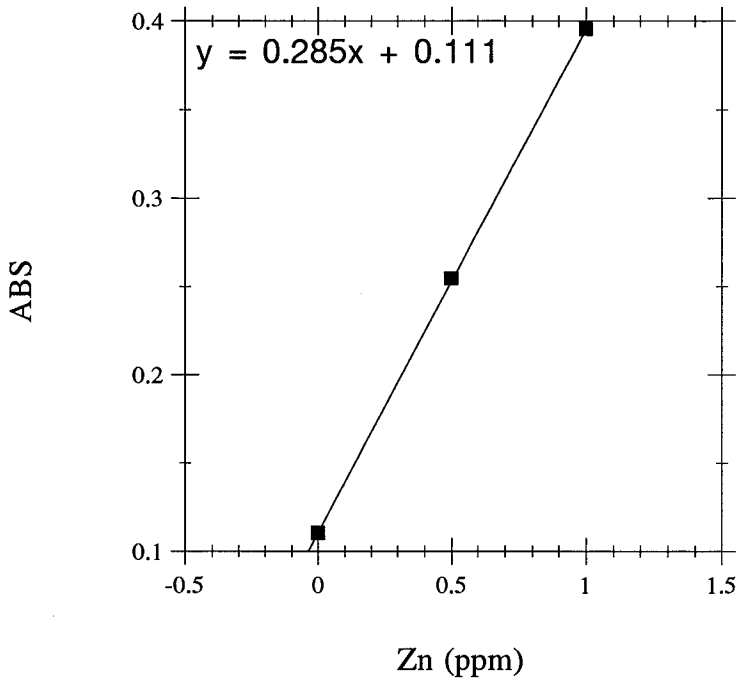

.107

x2 = .214

$.214 \times \frac{8\ g\ solw}{1.023\ g\ solid}$

1.67 ppm

SAN-023 $NH_2OH$



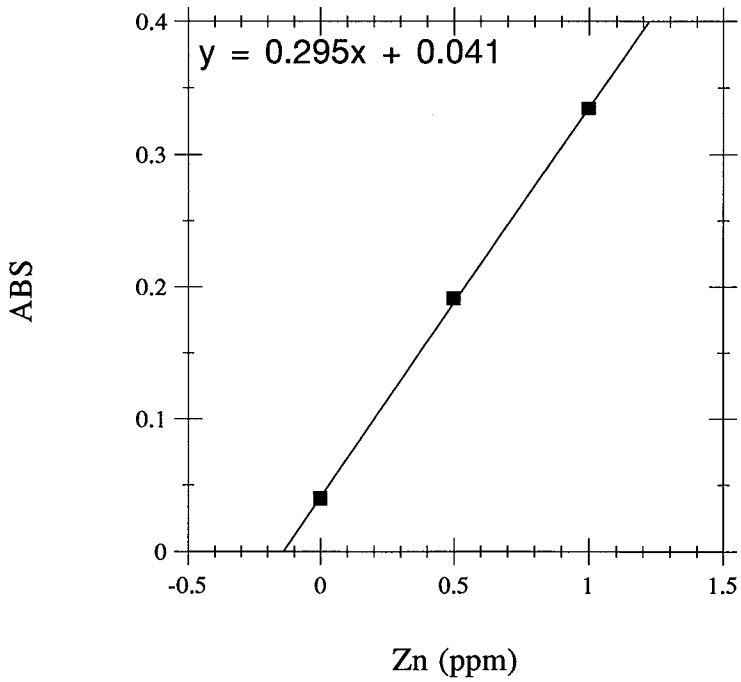

.389 ppm

x2 = .778 ppm

$.778 \times \frac{8 \text{ g soln}}{1.019 \text{ g solid}}$

6.11 ppm

SAN-030 $NH_2OH$




.139 ppm

×2 = .278 ppm

$.278 \times \frac{8\text{ g soln}}{1.023\text{ g sol.}}$

2.174 ppm

10/2/92
BWL

Santorini Metal analyses.

In an effort to determine whether there is any residual Cu and other metal elements found in bronze that had been leached from the bronze artifacts on the soil near where the articles had been found, aliquots of several samples were leached with a $MgCl_2$ solution (Tessier et al., 1979) (see 031/133).

This leach should release any adsorbed metals. Since Cu is dominant element in bronze, it was decided to analyze for this element first. Additional atomic absorption (AA) standards for Fe & Mn were made as well.

Cu: Standard Preparation. Using 1000 ppm Cu solution (Lot 913830-24) in 2% Nitric acid the following standards were made using volumetric glassware. The aliquot was diluted to the appropriate volume with 1.5 ml $HNO_3$ (Lot# 910962)/1000 ml solution. Using a 25 ml, 50, 250, & 1000 ml volumetric flasks and a volumetric pipet (1 ml) the following solutions were made. First a 1:10 dilution to make 100 ppm.

| | | |
|---|---|---|
| 1:25 | dilutions of the 100 ppm Cu solutions give the working standards with concentrations | 4 ppm |
| 1:50 | | 2 ppm |
| 1:250 | | 0.40 ppm |
| 1:1000 | | 0.10 ppm |

Mn: Standard Preparation: Using 1000 ppm Mn solution (Lot # 921488-24) in 2% Nitric Acid the following standard were made using volumetric glassware. First a 100 ppm solution was made by a 1:10 dilution. The diluent is 1.5 ml $HNO_3$/1000 ml. Then the following dilutions were made of the 100 ppm solution:

1:50 ⇒ 2 ppm
1:250 ⇒ 0.4 ppm
1:1000 ⇒ 0.1 ppm

Tessier, A., P. G.C. Campbell, & M. Bisson. 1979. Sequential Extraction Procedure for the Speciation of Particulate Trace Metals. Analytical Chemistry: 51. 844.

10/2/92
BWL

Fe: Standard Preparation: Using 1000ppm Fe solution (Lot # 922056-24) in 2% Nitric acid the following solutions were made using volumetric glassware. First a 100 ppm solution was made by a 1:10 dilution. The diluent in all dilutions is 1.5 ml $HNO_3$/100 ml. Then working standards were utilized by preparing further dilutions of the 100 ppm solution.

1:25 ⇒ 4.0 ppm
1:50 ⇒ 2.0 ppm
1:250 ⇒ 0.40 ppm.

It was decided first to analyze for Cu by AA. Because of the high salt (Mg) content of these solutions and the low Cu concentrations expected it was suggested (Tessier et al., 1979) that Cu by determined by standard additions method. The following four samples will be used.

SAN-WMM-005 - representative of soil beneath deposit
SAN-WMM-007 - bedrock beneath soil of deposit
SAN-WMM-008 - bedrock some 10 m away from deposit
SAN-WMM-009 - soil some 10 m away from artifact deposit.

The samples had been run in triplicate at a ratio of 1 gm sediment and 8 ml of 1M Mg·$Cl_2$ (pH=7) and shaken on a wrist shaker for 1 hours. The following results were obtained under the standard operating conditions for Cu with a multi-element lamp. Subsamples #2 & #3 represent an addition of 0.05 & 0.1 ml of 100ppm Cu standard.

| | |
|---|---|
| 005-1 | 0.08 |
| 005-2 | 1.11 |
| 005-3 | 1.99 |
| 007-1 | 0.07 |
| 007-2 | 1.09 |
| 007-3 | 2.08 |
| 008-1 | 0.06 |
| 008-2 | 1.07 |
| 008-3 | 2.13 |
| 009-1 | 0.08 |
| 009-2 | 1.06 |
| 009-3 | 2.06 |

These samples were determined by concentrations using a linear standard line using the blank 0.5 ml $HNO_3$/1000 ml and the 4.00 ppm Cu standard.

These preliminary results using a linear-least squares fitting of the data that

| | | |
|---|---|---|
| SAN-WMM-005 | 0.104/gm | |
| SAN-WMM-007 | 0.070/gm | Sediment |
| SAN-WMM-008 | 0.046/gm | |
| SAN-WMM-009 | 0.073/gm | |

These results are suggestive that there may be some Cu enrichment, however, these results should not be quoted and are preliminary. The solutions had been in contact with the sediments for over month. The conclusion is that this experiment should be repeated.

10/5/92 BWL Using the samples prepared by OL on (031/132) that have been in the dessicator we will repeat the experiment.

The subsamples were weighed on an analytical balance and transfered into tared, labeled 50 ml plastic centrifuge tubes.

| | Tube+Sed +Mg | Mass Used (g) | Tube+sed |
|---|---|---|---|
| SAN-WMM-005-A | 22.1943 | 1.0062 | 14.1514 |
| -005-B | 22.1312 | 1.0033 | 14.0978 |
| -005-C | 22.2781 | 1.0014 | 14.2465 |
| SAN-WMM-007-A | 21.8504 | 1.0010 | 13.8160 |
| -B | 22.3059 | 1.0018 | 14.2939 |
| -C | 22.2093 | 1.0011 | 14.1735 |
| SAN-WMM-008-A | 21.7762 | 1.0012 | 13.7478 |
| -B | 22.2614 | 1.0015 | 14.2247 |
| -C | 22.3450 | 1.0038 | 14.3116 |
| SAN-WMM-009-A | 22.2967 | 1.0021 | 14.2643 |
| -B | 22.2712 | 1.0015 | 14.2420 |
| -C | 21.8922 | 1.0014 | 13.8629 |
| Blank | 21.5870 | | 13.5593 |

10/6/92 BWL Samples were then given an 8 ml aliquot of 1.0 M $MgCl_2$ (pH = 7) (031/131) and reweighed. Samples were shaken on a wrist shaker for 1 hour. The samples were then centrifuged for ten minutes.

as is suggested by Tessier et al 1979. The following metals will need to be determined by standard additions: Cu, Pb, Zn, while Fe & Mn will need to be dilute aliquots of the supernate (20 to 50 x).

So that the standard additions can be done properly it will be necessary to take an aliquot of each of the splits (5 ml) then add 0.05 & 0.10 mls of 100 ppm Cu, Pb, Zn solutions and dilute to volume (10 ml) in volumetric flask with 1.5 ml $HNO_3$/1000 ml. Aliquot taken with Oxford adjustable pipet.

For the Fe/Mn analysis a 1 ml aliquot will be 1000 ul Eppendorf pipet. This aliquot will be diluted in deionized $H_2O$ to a volume of 25 ml in a volumetric flask.

The standards for Cu, Pb, & Zn should be made with the acidified $H_2O$ as a dilutant. The Cu standards have already been made (024/167).

10/6/92 T.G.

Purpose:

Using Copper, Iron, Zinc, Lead, and Manganese Reference solutions suitable for atomic absorption spectroscopy, various concentrations were made for the approximate determination of the metals found in the soils in Greece.

Materials:

1000 ppm $Cu(NO_3)_2$ in 2% $HNO_3$ (T.G. Lot# 913830-24)
1000 ppm $Fe(NO_3)_3$ in 2% $HNO_3$ (Lot#922056-24)
1000 ppm ZnO in 5% $HNO_3$ (Lot#915748-24)
1000 ppm $Pb(NO_3)_2$ in 2% $HNO_3$ (Lot#910034-24)
1000 ppm $Mn(NO_3)_2$ in 2% $HNO_3$ (Lot#921488-24)

100 ml, Class A Volumetric flasks

Cont. 1-10 ml, Class A pipets
~~Eppendorf~~ T.G.
200-1000 uL Eppendorf pipetters
125 ml PP bottles
Several liters of nanopure water.

Procedure:

Using only clean, acid-washed pipets and volumetric flasks, 100 ~~ppm~~ T.G. solutions were ~~diluted~~ T.G. made by diluting each of the 1000 ppm solutions mentioned in the materials list. To do this:

1.) Rinse the pipet with the solution being diluted and then draw 10 ml into the pipet for transfer into the 100 ml Volumetric flask.
2.) Add nanopure water to the flask until the meniscus bottom lies on the mark.
3.) Holding the flasks lid on, shake the volumetric to ensure complete reaction.
4.) Pour the 100 ml (100 ppm) solution into a labeled, 125 ml PP bottle and label accordingly.

5.) If necessary, serial dilutions or more dilutions from the original 1000 ppm Reference solution can be made by following the previous procedures.

10/6/92 T.G.

Purpose:

To determine whether the Santorini metals of interest ~~were~~ T.G. (are) bound in carbonates ~~or~~ and T.G. Iron-Manganese oxides, 5.0 pH, NaOAc and 0.04 M $NH_2OH \cdot HCl$ (in 25% v/v HOAc), respectively, were made. ~~to Determining the extent of~~ T.G. leaching due to carbonate and oxide bonding decreases the observable concentration of the metals in the soil. The above solutions were made to decrease the binding, thereby increasing the number of free metal ions.

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Reagents:

Sodium Acetate (ACS certified) Lot # 905630
Hydroxlamine Hydrochloride (ACS certified) Lot # $NH_2OH \cdot HCl$
Acetic Acid, Glacial (Reagent A.C.S.) Lot # 893419

Materials:

2-500ml Volumetric flasks ±.001g T.G. 10/6/92
Mettler ~~240~~ AE 240 and PM4600 Balances ±.1g
pH electrode & Meter.

Procedures:

To make 0.04 M $NH_2OH \cdot HCl$ in 25% (v/v) HOAc:

1.) For a 500 ml solution, add 125 ml HOAc to the empty volumetric or weigh [125ml * 1.05g/ml = 131.3g HOAc] 131.3g HOAc into the flask using the balance similar to our PM4600.
2.) Slowly add DI water until ≈ 300ml are in the flask. Swirl.
3.) Weigh out --
$0.04\,M\,NH_2OH \cdot HCl * \frac{64.9g}{mole} * \frac{1L}{1000ml} * 500ml = 1.3898\,g\,NH_2OH \cdot HCl$ --
1.3898g $NH_2OH \cdot HCl$ on a balance ~~simit~~ T.G. w/ ±1mg accuracy and rinse the solid into the flask.
4.) Add DI water until ~ 1-2" in below the mark and swirl. Let the flask solution mix and then dilute to the mark. Reswirl and pour into a dated, labeled PP bottle.

To make 1 M NaOAc (pH = 5):

1.) For a 500 ml solution, weigh --
$1\,M\,NaOAc \cdot 3H_2O * \frac{136.08g}{mol} * \frac{1L}{1000ml} * 500ml = 68.04\,g\,NaOAc \cdot 3H_2O$ --
68.04g $NaOAc \cdot 3H_2O$ into a clean, acid-washed 250 ml beaker
2.) With ~ 200 ml already in the flask, sweep the crystals from the beaker into the flask.
3.) Rinse the remaining crystals into the beaker by washing w/ ~25ml of DI water per rinse & swirl the flask once you get near the mark. Finish diluting to mark.
4.) Using glacial acetic acid and a pH meter, slowly add dropwise, with a Pasteur pipet, some of HOAc in a well-vented area. Make sure that there is constant stirring. Add HOAc until the pH is adjusted to 5.00.

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Standard additions for Cu, Zn, Pb analysis of 'exchangeable fraction'. The linear range of Zn is 0-1 ppm, Pb (0-20 ppm) and Cu (0-5 ppm) the following scheme will be used. The 100 ppm stock solutions made up by TG on 024/171 will be used to make additions. Because each sample (eg 005) is in triplicate (A, B, C) a standard addition is possible for each A, B, or C the following quantities of Cu, Pb, Zn are added

| | A | B | C | in ml |
|---|---|---|---|---|
| Pb | 0 | .05 | .1 | |
| Zn | 0 | .025 | .05 | |
| Cu | 0 | .05 | .1 | |

this gives the following concentrations once they have been diluted to 10 ml in volumetric flask (Class A) with 15 ml $HNO_3$/ 1000 ml DIW. Thus each A, B, C sample had a five ml aliquot of supernate transfered, plus the amounts of 100 ppm Cu, Zn, Pb solutions added.

| concentration (ppm) | A | B | C |
|---|---|---|---|
| Pb | — | 1 | 2 |
| Zn | — | 0.5 | 1.0 |
| Cu | — | 1 | 2 |

note 007-C diluted to slightly more than 10 ml.

10/7/92 Sample aliquots taken from the Santorini leaching experiment of samples SAN-WMM-005, xx-xx-007, -008, & 009 were analyzed for Pb, Zn, Cu, Fe, Mn. The leachate was $MgCl_2$ (pH=7). After the aliquots were taken the remaining solution was decanted. The samples were then washed with 8 ml of deionized $H_2O$. The $H_2O$ was added using a 5ml & 3ml setting on the adjustable Oxford pipet. All the tubes were capped, agitated on the homogenizer, and centrifuged for 30 minutes. The deionized $H_2O$ was then decanted.

The sample centrifuge (50 ml polypropylene) tubes were opened and to each tube, 8 mls of a 1M NaOAc solution that had been adjusted to pH=5 with acetic acid, were added, using a 5ml and 3 ml transfer volume delivered by the Oxford pipet. This reagent is documented on 024/172. The sample tubes were capped and then agitated on the wrist shaker for 5 hours.

After 5 hours of agitation the tubes were centrifuged for 30 minutes on 7 using the IEC Clinical Centrifuge. Then the supernate were sampled as follows:

Cu, Pb, Zn - subsample: These AA analyses will be by the method of the standard addition. So each A, B, C solution was assumed to be identical. Using a oxford adjustable pipet & disposable tips a 5 ml aliquot was carefully removed and placed into a 10 ml Class A Volumetric Flask. Using AA the linear range for Zn (0-1 ppm), Pb (0-20 ppm) & Cu (0-5 ppm) Using the 100 ppm stock solutions of each element (024/171) the following additions will be made with fixed volume Eppendorf pipets. Samples labels are of the form 5-A*C representing 005-A*C carbonate leachate

| element | addition ml / conc added | A | B | C |
|---|---|---|---|---|
| Pb | ~~0/0~~ | 0/0 | 0.05/1 | 0.1/2 |
| Zn | ~~0/0~~ | 0/0 | 0.025/0.5 | 0.05/1 |
| Cu | ~~0/0~~ | 0/0 | 0.05/1 | 0.1/2 |

Then all aliquots were diluted to 10 ml using 1.5 ml $HNO_3$/1000 ml. (024/167)

Fe, Mn subsample: These aliquots will be diluted to variable volumes using the acidic dilutant (024/167). The aliquots were all 1.00 ml delivered by an Eppendorf 1000µl fixed volume pipet with disposable tips. The diluted volumes are given below.

| | | |
|---|---|---|
| A | 1:25 | 5, 7, 8, & 9 |
| B | 1:10 | " " |
| C | 1:10 | " " |

Samples labeled as 005-A~~*~~ C-Fe*25 where it represents the Fe fraction diluted to 25 ml

Blanks for Cu/Pb/Zn and Fe/Mn are simply 5 ml and 1 ml of the Na-acetate solution diluted to 10 ml with 1.5 ml $HNO_3$/1000 ml.

10/8/92 BWL The remaining supernate was decanted and placed down the sink. 8 ml of deionized $H_2O$ was then added to each tube by delivery of a 3 & 5 ml aliquot from a 5 ml variable volume Oxford pipet. Each tube was capped and then agitated on the Vortex Genie 2 mixer. The tubes were then centrifuged for ½ hour and the supernate decanted into the sink.

The sample centrifuge tubes were opened and to each, 8 mls of a 0.04 M $NH_2OH \cdot HCl$ in 25% (v/v) $HOAc$ (24/172) solution was added using a 3 & 5 ml aliquot delivered by a 5 ml Oxford pipet (adjustable). The sample tubes were capped and then agitated on the wrist shaker for 5 hours.

After 5 hours the samples were removed and centrifuged for 30 minutes. continued on page ~~180~~. 181 BWL 10/12/92

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The atomic absorption spectrometry results for the $MgCl_2$, Na·acetate (pH=5), and Hydroxylamine-HCl - acetic ~~Lea~~ BWL 10/12/92 acid leaches are given below. Using a Perkin Elmer Model 3100;
The following conditions were used during AA analysis. a multielement lamp (Fe, Mn, Zn, Cu,) and a single element Pb lamp.

| Element | (ma) voltage | (nm) λ | (nm) slit | Height Resolver | Air | Acetylene |
|---|---|---|---|---|---|---|
| Cu | 15 ma | 324.8 | 0.2 | H | 4 | 2.5 |
| Zn | " " | 213.9 | " " | H | 4 | 2.5 |
| Fe | " " | 248.3 | " " | H | 4 | 2.5 |
| Mn | " " | 279.5 | 0.2 | H | 4 | 2.5 |
| Pb | " " | 217.0 | 0.2 | H | 4 | 2.5 |

All samples were run in the flame mode with Fe & Mn analyses ~~accomplished~~ BWL 10/12/92 accomplished by running the 3100 using a linear calibration and standards (024/170) that had been diluted to volume such that any matrix affects were minimized. For example: in $MgCl_2$ leach if 1 ml of sample had been diluted to 25 ml with dilute acid (024/168) then the standards of Fe were 1/25 $MgCl_2$ leachant. These analyses for Fe & Mn were diluted by either a 1:10 or 1:25 dilution, as suggested by Tessier et al. 1979.
Since our system doesn't have a printer associated with only the display information is available for analysis.

Parameters used in the Fe&Mn analyses are as follows:
Integration Time = 3 sec
Replicates = 3
Calibration = Linear
Technique = Flame
Std = 2 or 3

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Autoradiographic thin section samples were detached from the CR-39 plastic. Total exposure time ≅ 4 days; 16 hours; 20 minutes

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The supernate was sampled after 5 hours of agitation and 30 minutes of centrifugation.

Cu, Pb, Zn - subsample: These AA analyses will be by the method of standard addition. Each A, B & C sediment & supernate aliquot was assumed to be identical. Using an Oxford adjustable pipet and disposable tips a 5 ml aliquot was carefully removed and placed into a 10 ml class A volumetric Flask. Using the AA the linear range for Zn (0-1 ppm), Pb (0-20 ppm) & Cu (0-5 ppm) Using the 100 ppm stock solutions of each element (024/171) the following additions will be made with fixed volume Eppendorf pipettes. Samples labels are of the form 5-A*3 representing SAN-WMM-005-A subjected to the hydroxylamine chydrochloride - acetic acid leachant (024/172).

The standard addition scheme is as follows:

| Element/sample | Addition ml/ | Concentration Added |
|---|---|---|
| Pb -A | 0 | 0 |
| -B | 0.05 | 1.00 |
| -C | 0.10 | 2.00 |
| Cu -A | 0 | 0 |
| -B | 0.05 | 1.00 |
| -C | 0.10 | 2.00 |
| Zn -A | 0 | 0 |
| -B | 0.025 | 0.50 |
| -C | 0.05 | 1.00 |

all aliquots were diluted ~~were~~ BWC 10/12/92 to 10 ml using 1.5 ml $HNO_3$/1000 ml (024/167).

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Fe, Mn subsample: These aliquots were diluted to 10 or 25 ml using the acidic dilutant (024/167) using Class A volumetric flasks. The aliquots were all 1.00 ml delivered by an Eppendorf 1000 µl fixed volume pipet with disposable tips. The diluted volumes are given below

A = 1:10 & B = 1:25, C = 1:25

The sample designations are 005-A*3-Fe 10 or
005-A*3-Fe 25

where the 10 or 25 after Fe represents the dilution factor. Blanks for Cu/Pb/Zn and Fe/Mn are simply 5 ml and 1 ml of Hydroxylamine-hydrochloride-acetic acid reagent diluted to 10 ml with acidified dilutant, respectively.

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AA analysis of trace metals in ~~leachates of~~ BWL 10/13/92 leachates of Santorini samples. Because there is no printer associated with the AA in a linear calibration mode only the absorbance of the 1st standard is displayed. Subsequent standards calculated concentration are displayed. For example, the analysis of Fe in Mg(ll) leach experiment used the blank for zero concentration and 0.50 ppm and 1.00 ppm Fe standards for the linear calibration. From the table below an absorbance of 0.023 was read for the 0.50 ppm Fe Standard. The acquisition of the 1.00 ppm then predicted the concentration of 1.02 ppm from a linear calibration of the 0, .5 pair.

Thus the following data tables for Fe & Mn consist of two parts. The first part (upper portion) is the calculated concentrations of the samples based upon the linear calibration of Fe or Mn standards. The lower portion gives the information obtained during standard linear calibration acquisition. The concentrations in the following two tables do not reflect any corrections due to dilutions.

# AA ANALYSIS SANTORINI



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**Fe Concentrations**

| MgCl2 Leach | | | Na acetate -acetic acid | | | Hydroxylamine hydrochloride-acetic acid | | |
|---|---|---|---|---|---|---|---|---|
| Sample | Fe (ppm) | | Sample | Fe (ppm) | | Sample | Fe (ppm) | |
| 005-A*Fe25 | 0.01 | | 005-A*C-Fe25 | 0.00 | | 005-A*3-Fe10 | 1.20 | |
| 005-B*Fe25 | 0.02 | | 005-B*C-Fe10 | 0.00 | | 005-B*3-Fe25 | 0.49 | |
| 005-C*Fe25 | 0.01 | | 005-C*C-Fe10 | 0.00 | | 005-C*3-Fe25 | 0.50 | |
| 007-A*Fe25 | 0.01 | | 007-A*C-Fe25 | 0.00 | | 007-A*3-Fe10 | 1.33 | |
| 007-B*Fe25 | 0.02 | | 007-B*C-Fe10 | 0.00 | | 007-B*3-Fe25 | 0.51 | |
| 007-C*Fe25 | 0.01 | | 007-C*C-Fe10 | 0.00 | | 007-C*3-Fe25 | 0.52 | |
| 008-A*Fe25 | 0.01 | | 008-A*C-Fe25 | 0.03 | | 008-A*3-Fe10 | 0.98 | |
| 008-B*Fe25 | 0.01 | | 008-B*C-Fe10 | 0.16 | | 008-B*3-Fe25 | 0.38 | |
| 008-C*Fe25 | 0.01 | | 008-C*C-Fe10 | 0.16 | | 008-C*3-Fe25 | 0.37 | |
| 009-A*Fe25 | 0.01 | | 009-A*C-Fe25 | 0.00 | | 009-A*3-Fe10 | 0.97 | |
| 009-B*Fe25 | 0.00 | | 009-B*C-Fe10 | 0.00 | | 009-B*3-Fe25 | 0.39 | |
| 009-C*Fe25 | 0.01 | | 009-C*C-Fe10 | 0.00 | | 009-C*3-Fe25 | 0.37 | |
| | | | | | | | | |
| **Known Concentration** | 0.50 | 1.00 | 0.50 | 1.00 | 5.00 | 0.50 | 1.00 | 5.00 |
| **Absorbance** | 0.023 | | 0.024 | | | 0.024 | | |
| **Calculated Concentration** | | 1.02 | | 1.03 | 4.99 | | 1.12 | 4.97 |

**Mn Concentrations**

| MgCl2 Leach | | | Na acetate -acetic acid | | | Hydroxylamine hydrochloride-acetic acid | | |
|---|---|---|---|---|---|---|---|---|
| Sample | Mn (ppm) | | Sample | Mn (ppm) | | Sample | Mn (ppm) | |
| 005-A*Fe25 | 0.06 | | 005-A*C-Fe25 | 0.178 | | 005-A*3-Fe10 | 1.618 | |
| 005-B*Fe25 | 0.07 | | 005-B*C-Fe10 | 0.446 | | 005-B*3-Fe25 | 0.623 | |
| 005-C*Fe25 | 0.07 | | 005-C*C-Fe10 | 0.449 | | 005-C*3-Fe25 | 0.624 | |
| 007-A*Fe25 | 0.01 | | 007-A*C-Fe25 | 0.070 | | 007-A*3-Fe10 | 0.305 | |
| 007-B*Fe25 | 0.01 | | 007-B*C-Fe10 | 0.175 | | 007-B*3-Fe25 | 0.114 | |
| 007-C*Fe25 | 0.01 | | 007-C*C-Fe10 | 0.175 | | 007-C*3-Fe25 | 0.111 | |
| 008-A*Fe25 | 0.01 | | 008-A*C-Fe25 | 0.034 | | 008-A*3-Fe10 | 0.094 | |
| 008-B*Fe25 | 0.01 | | 008-B*C-Fe10 | 0.082 | | 008-B*3-Fe25 | 0.035 | |
| 008-C*Fe25 | 0.01 | | 008-C*C-Fe10 | 0.080 | | 008-C*3-Fe25 | 0.035 | |
| 009-A*Fe25 | 0.01 | | 009-A*C-Fe25 | 0.096 | | 009-A*3-Fe10 | 1.967 | |
| 009-B*Fe25 | 0.01 | | 009-B*C-Fe10 | 0.231 | | 009-B*3-Fe25 | 0.772 | |
| 009-C*Fe25 | 0.01 | | 009-C*C-Fe10 | 0.232 | | 009-C*3-Fe25 | 0.763 | |
| | | | | | | | | |
| **Known Concentration** | 0.10 | 1.00 | 0.10 | 0.50 | 2.00 | 0.10 | 0.50 | 2.00 |
| **Absorbance** | 0.012 | | 0.012 | | | 0.011 | | |
| **Calculated Concentration** | | 1.02 | | 0.49 | 2.00 | | 0.49 | 2.00 |

The true concentration in units of ppm or $\frac{\mu g \text{ metal}}{g \text{ solution}}$ is then determined by multiplying the result by its dilution factor.

For Example Mn: 005-A*3-Fe10 = 1.618 x10 = 16.18 ppm
005-A*3-Fe25 = 0.623 x25 = 15.58 ppm.

# AA Analysis Santorini Leachates

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For standard addition analyses only absorbances are recorded. The following tables represents the data for Pb, Zn & Cu.

Pb Absorbance

| | MgCl2 Leach | | | Na acetate -acetic acid | | Hydroxylamine hydrochloride-acetic acid | | |
|---|---|---|---|---|---|---|---|---|
| Sample | Pb added (ppm) | Absorbance | Sample | Pb added (ppm) | Absorbance | Sample | Pb added (ppm) | Absorbance |
| 005-A | 0.00 | 0.003 | 005-A*C | 0.00 | 0.004 | 005-A*3 | 0.00 | 0.002 |
| 005-B | 1.00 | 0.015 | 005-B*C | 1.00 | 0.017 | 005-B*3 | 1.00 | 0.017 |
| 005-C | 2.00 | 0.029 | 005-C*C | 2.00 | 0.030 | 005-C*3 | 2.00 | 0.033 |
| 007-A | 0.00 | 0.003 | 007-A*C | 0.00 | 0.004 | 007-A*3 | 0.00 | 0.001 |
| 007-B | 1.00 | 0.016 | 007-B*C | 1.00 | 0.017 | 007-B*3 | 1.00 | 0.016 |
| 007-C | 2.00 | 0.029 | 007-C*C | 2.00 | 0.030 | 007-C*3 | 2.00 | 0.032 |
| 008-A | 0.00 | 0.003 | 008-A*C | 0.00 | 0.004 | 008-A*3 | 0.00 | 0.000 |
| 008-B | 1.00 | 0.016 | 008-B*C | 1.00 | 0.017 | 008-B*3 | 1.00 | 0.016 |
| 008-C | 2.00 | 0.029 | 008-C*C | 2.00 | 0.030 | 008-C*3 | 2.00 | 0.032 |
| 009-A | 0.00 | 0.003 | 009-A*C | 0.00 | 0.005 | 009-A*3 | 0.00 | 0.002 |
| 009-B | 1.00 | 0.016 | 009-B*C | 1.00 | 0.017 | 009-B*3 | 1.00 | 0.017 |
| 009-C | 2.00 | 0.028 | 009-C*C | 2.00 | 0.029 | 009-C*3 | 2.00 | 0.033 |

Zn Absorbance

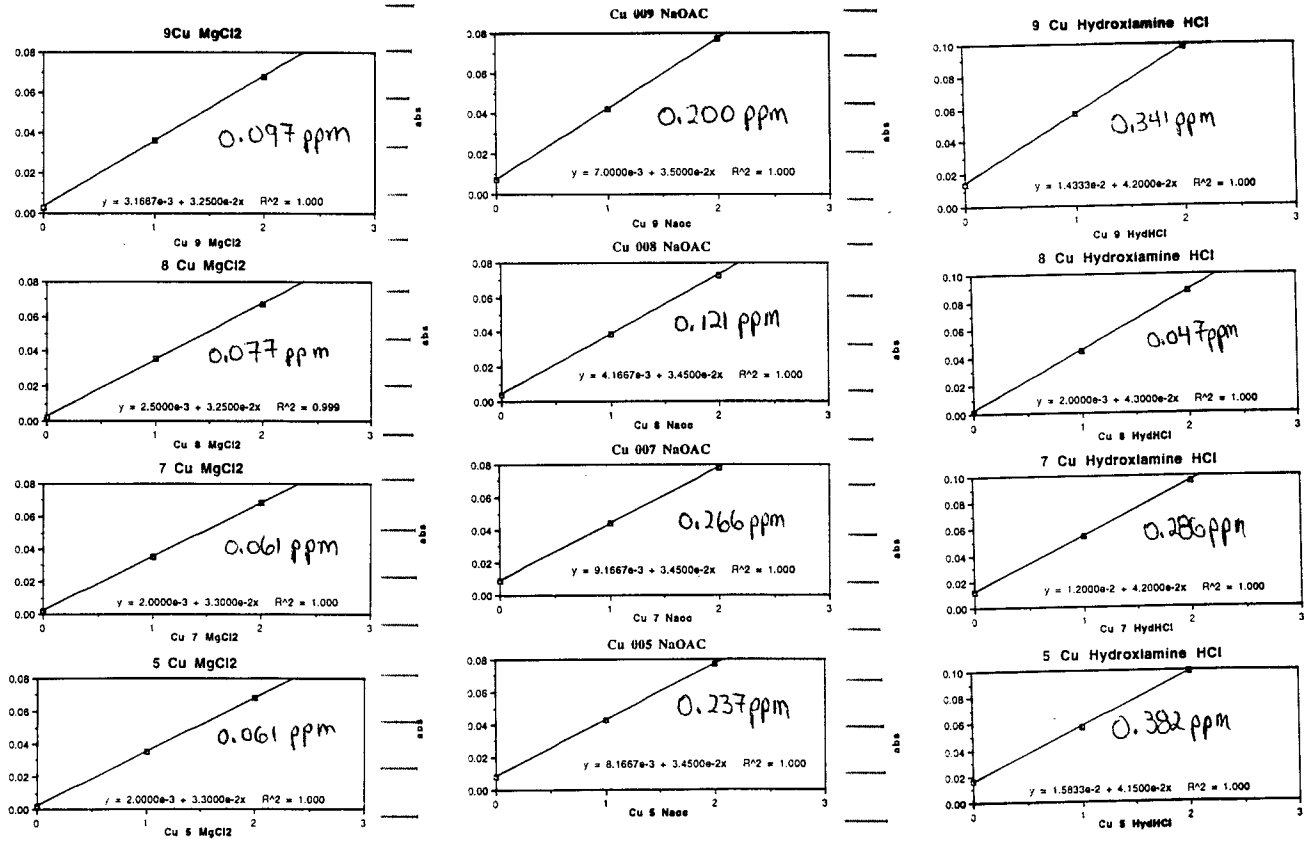
| | MgCl2 Leach | | | Na acetate -acetic acid | | Hydroxylamine hydrochloride-acetic acid | | |
|---|---|---|---|---|---|---|---|---|
| Sample | Zn added (ppm) | Absorbance | Sample | Zn added (ppm) | Absorbance | Sample | Zn added (ppm) | Absorbance |
| 005-A | 0.00 | 0.003 | 005-A*C | 0.00 | 0.018 | 005-A*3 | 0.00 | 0.102 |
| 005-B | 0.50 | 0.052 | 005-B*C | 0.50 | 0.030 | 005-B*3 | 0.50 | 0.167 |
| 005-C | 1.00 | 0.099 | 005-C*C | 1.00 | 0.041 | 005-C*3 | 1.00 | 0.229 |
| 007-A | 0.00 | 0.004 | 007-A*C | 0.00 | 0.016 | 007-A*3 | 0.00 | 0.060 |
| 007-B | 0.50 | 0.053 | 007-B*C | 0.50 | 0.028 | 007-B*3 | 0.50 | 0.128 |
| 007-C | 1.00 | 0.101 | 007-C*C | 1.00 | 0.041 | 007-C*3 | 1.00 | 0.195 |
| 008-A | 0.00 | 0.005 | 008-A*C | 0.00 | 0.021 | 008-A*3 | 0.00 | 0.016 |
| 008-B | 0.50 | 0.053 | 008-B*C | 0.50 | 0.032 | 008-B*3 | 0.50 | 0.086 |
| 008-C | 1.00 | 0.100 | 008-C*C | 1.00 | 0.044 | 008-C*3 | 1.00 | 0.153 |
| 009-A | 0.00 | 0.009 | 009-A*C | 0.00 | 0.015 | 009-A*3 | 0.00 | 0.114 |
| 009-B | 0.50 | 0.054 | 009-B*C | 0.50 | 0.026 | 009-B*3 | 0.50 | 0.181 |
| 009-C | 1.00 | 0.099 | 009-C*C | 1.00 | 0.038 | 009-C*3 | 1.00 | 0.241 |

Cu Absorbance

| | MgCl2 Leach | | | Na acetate -acetic acid | | Hydroxylamine hydrochloride-acetic acid | | |
|---|---|---|---|---|---|---|---|---|
| Sample | Cu added (ppm) | Absorbance | Sample | Cu added (ppm) | Absorbance | Sample | Cu added (ppm) | Absorbance |
| 005-A | 0.00 | 0.002 | 005-A*C | 0.00 | 0.008 | 005-A*3 | 0.00 | 0.016 |
| 005-B | 1.00 | 0.035 | 005-B*C | 1.00 | 0.043 | 005-B*3 | 1.00 | 0.057 |
| 005-C | 2.00 | 0.068 | 005-C*C | 2.00 | 0.077 | 005-C*3 | 2.00 | 0.099 |
| 007-A | 0.00 | 0.002 | 007-A*C | 0.00 | 0.009 | 007-A*3 | 0.00 | 0.012 |
| 007-B | 1.00 | 0.035 | 007-B*C | 1.00 | 0.044 | 007-B*3 | 1.00 | 0.054 |
| 007-C | 2.00 | 0.068 | 007-C*C | 2.00 | 0.078 | 007-C*3 | 2.00 | 0.096 |
| 008-A | 0.00 | 0.002 | 008-A*C | 0.00 | 0.004 | 008-A*3 | 0.00 | 0.002 |
| 008-B | 1.00 | 0.036 | 008-B*C | 1.00 | 0.039 | 008-B*3 | 1.00 | 0.045 |
| 008-C | 2.00 | 0.067 | 008-C*C | 2.00 | 0.073 | 008-C*3 | 2.00 | 0.088 |
| 009-A | 0.00 | 0.003 | 009-A*C | 0.00 | 0.007 | 009-A*3 | 0.00 | 0.014 |
| 009-B | 1.00 | 0.036 | 009-B*C | 1.00 | 0.042 | 009-B*3 | 1.00 | 0.057 |
| 009-C | 2.00 | 0.068 | 009-C*C | 2.00 | 0.077 | 009-C*3 | 2.00 | 0.098 |

ences 2/13/92
2 BWL

Using the concentrations of added element and the measured absorbance the concentration can be determined by plotting the results and determining the linear least-squared fit of the data. From the equation of the line y = 0 and the concentration x is solved. The following figures give the best fit lines for all the analyses and the calculated concentrations of each sample.



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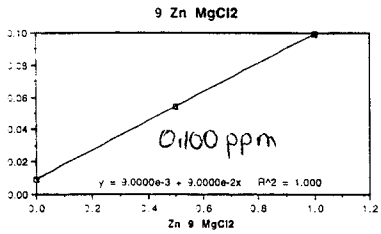


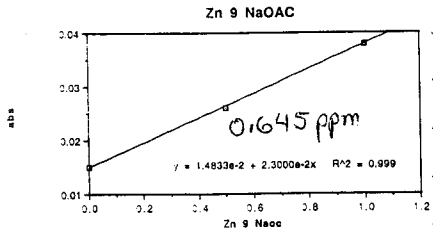


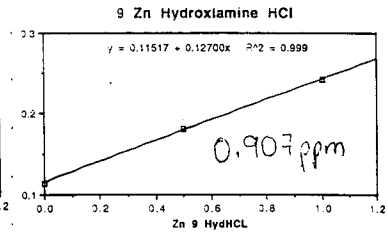


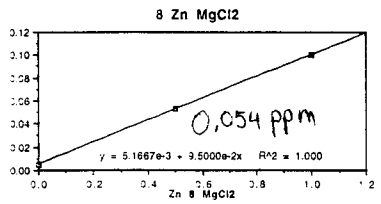


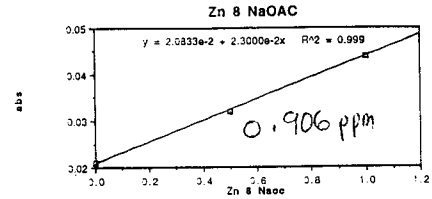


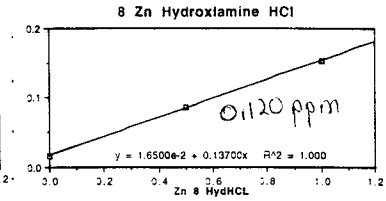


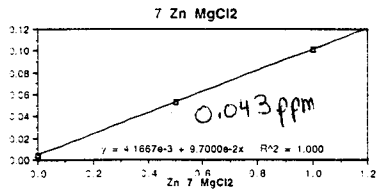


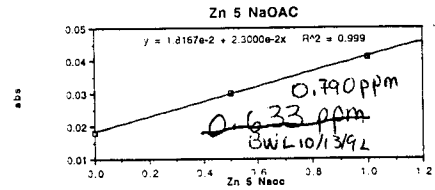


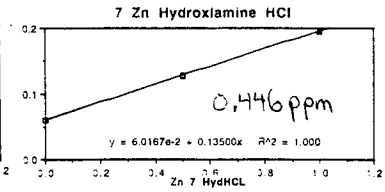


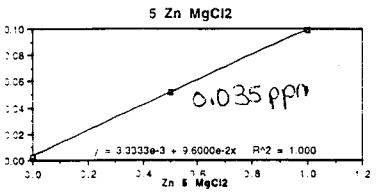


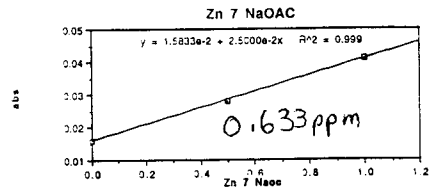


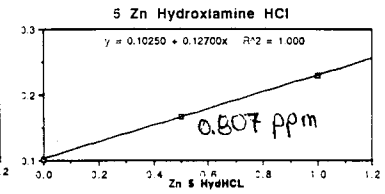


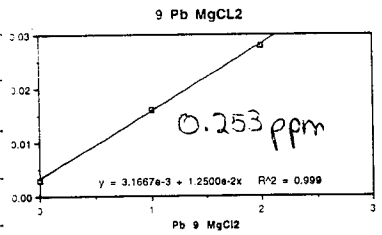


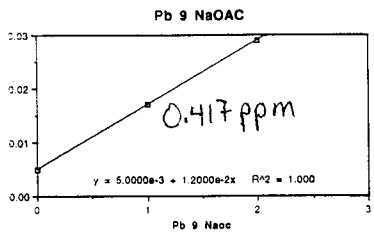


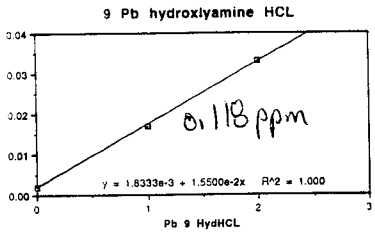


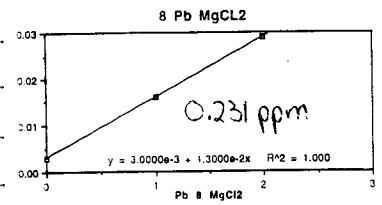


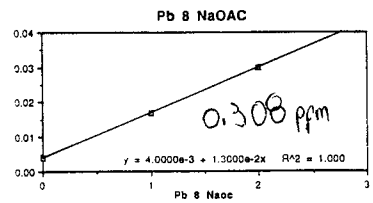


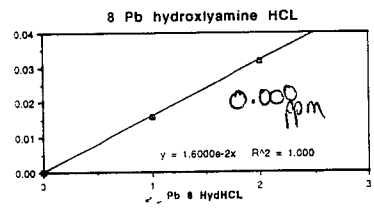


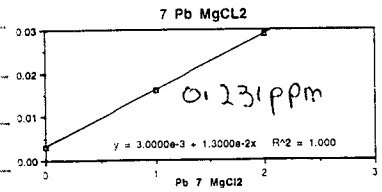


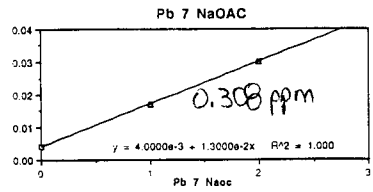


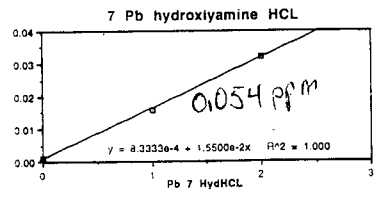


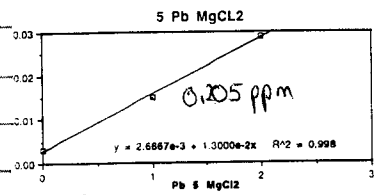


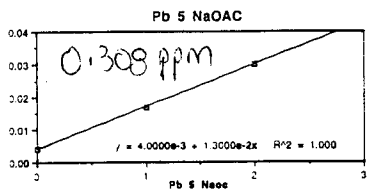


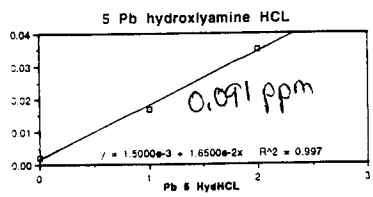

10/13/92
BWL

The final results for Pb, Zn & Cu are calculated as follows: From the figures the concentration is multiplied by the solution mass to solid mass ratio.

Eg. SAN-WMM-009 for Zn Hydroxylamine HCl

$$0.907 \text{ ppm} \frac{8 \text{ g solution}}{1.00 \text{ g solid}} = 7.26 \text{ ppm}$$

The figure of 1.00 gram comes from the average of the masses of the solids used (024/169).

For the Fe & Mn numbers the results for A, B, C are calculated by multiplying by the dilution factor and the leachate to solid mass ratio.

Eg. SAN-WMM-005-A*3-Fe10

$$\frac{1.618 \times 10 \times 8}{1.0062} = 128.64 \text{ ppm}$$

The results of each A, B, & C are averaged and the average is presented below. The carbonate fraction = Na acetate pH=5 & Mn-Fe oxides is the hydroxylamine-hydrochloride-acetic acid leachant.

Santorini Leach Results

| | | | | | |
|---|---|---|---|---|---|
| | | MgCl Exchangeable | | | |
| Sample | Cu | Zn | Pb | Fe | Mn |
| 5 | 0.49 | 0.28 | 1.64 | 2.66 | 13.29 |
| 7 | 0.49 | 0.34 | 1.85 | 2.66 | 2.00 |
| 8 | 0.62 | 0.43 | 1.85 | 2.00 | 2.00 |
| 9 | 0.78 | 0.80 | 2.02 | 1.33 | 2.00 |
| | | Carbonate fraction | | | |
| Sample | Cu | Zn | Pb | Fe | Mn |
| 5 | 1.90 | 6.32 | 2.46 | 0.00 | 35.60 |
| 7 | 2.13 | 5.06 | 2.46 | 0.00 | 13.98 |
| 8 | 0.97 | 7.25 | 2.46 | 10.51 | 6.57 |
| 9 | 1.60 | 5.16 | 3.34 | 0.00 | 18.72 |
| | | Mn-Fe oxides | | | |
| Sample | Cu | Zn | Pb | Fe | Mn |
| 5 | 3.06 | 6.46 | 0.73 | 97.65 | 125.82 |
| 7 | 2.29 | 3.57 | 0.43 | 104.00 | 23.10 |
| 8 | 0.38 | 0.96 | 0.00 | 75.97 | 7.16 |
| 9 | 2.73 | 7.26 | 0.94 | 76.41 | 154.53 |